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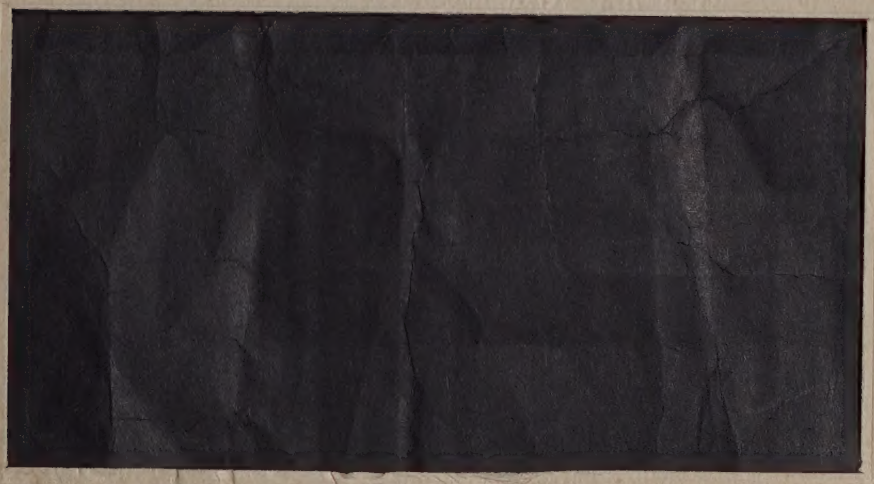

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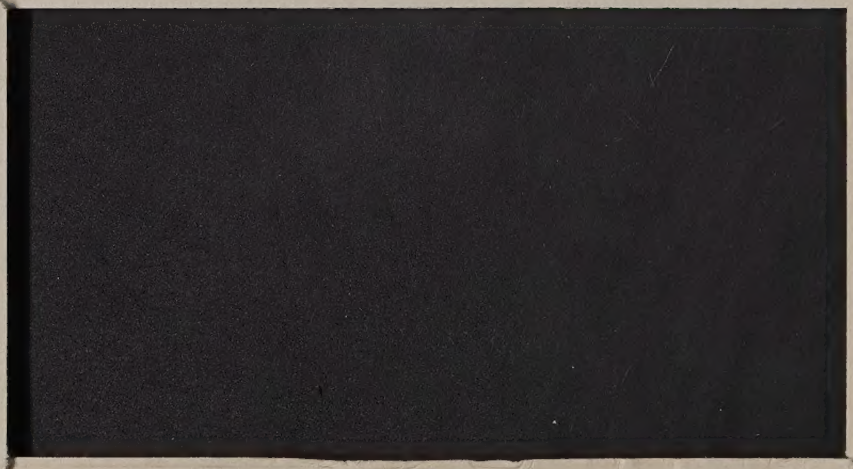

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OUL 512

Optical

UV Recorder

OM 1502

TECHNICAL AND MAINTENANCE MANUAL

820809

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mm/s
DM 4502
Schlumberger

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A - Propriétés de la matière ...

1.A.1 - Pages ...

1.A.2 - Corrosion ...

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GENERAL

1 - GENERAL

The OM 4502 portable UV recorder provides for simultaneous record of 12 parameters, in Cartesian coordinates, on daylight printing chart paper.

Compact and rugged design, combined with an easily transportable case and remote control unit, make this machine suitable for all general applications.

Main features are:

- 12 write channels, using pen type mirror galvanometers (direct or with 6 type OA 4571/0 double amplifiers).
- 8 different paper speeds, remote controlable.
- 6 associated plug-in double amplifiers, with high input impedance ensuring immediate matching to the galvanometers, with no calculation of impedance or damping factors.
- Measurement references independent of paper run.
- Remote control facility.
- Easy access to the various elements, such as light sources, galvanometers, etc.
- Option:
    - . Thermostatically controlled magnetic block, for operation of the recorder over a temperature range from 0 to +40°C.
- Ancillary equipment:
    - . OM 4515/1 coded time base, using 50 Hz line supply
    - . OM 4522 crystal-driven coded time base
    - . OA 4572/0 power supply for 6 amplifiers or 6 auxiliary units
    - . 6 type OA 4571/0 double amplifiers (12 measurement channels)
    - . 6 type OM 4509/2 amplifiers (6 measurement channels)
    - . 6 type OM 4509/4 high input impedance amplifiers (6 measurement channels)
    - . 6 type OM 4509/1 amplifiers for thermocouples (6 measurement channels)
    - . 6 type OM 4509/3 auxiliary units for strain-gauges (6 measurement channels)
    - . OM 4510/3 HT attenuator, 1/50 - 1/500 (6 measurement channels).

. OM 4510/1 or OM 4510/2 passive adaptors
. OM 4521/0 tape run timer unit
. OA 4573/0 paper take-up
. OM 4524/0 rack-mounting adaptor
. OM 4512/0 adaptor for airborne installation
.OM 4513/0 accessories case.

1.1 - Principle of operation

The spot traces are written on a UV-sensitive emulsion, and appear after exposure to ambient light, no chemical processing being required.

A number of sub-assemblies are involved in the data recording process defined above:

- Paper drive system
- Optical elements
- Power supply
- Controls
- Auxiliaries.

1.1.1 - Paper drive system

This system incorporates, in addition to the electric motor:

- Paper drive device, comprising capstan, pinch-roller, and drive roller.

- Electro-magnetically controlled gearbox, defining the different paper speeds.

1.1.2 - Optical elements

These comprise:

- Light sources
- Galvanometers
- Electro-magnetic signals.

1.1.2.1 - Light sources

a) An HP mercury vapour lamp is used for writing data, millimetric lining, and spot identification. This lamp is protected by a cover, the dimensions of which ensure correct ventilation.

   A high output regulated power supply provides the power required for operation of this lamp.

b) A rectilinear flashlamp is used for time marking. This lamp is controlled by a coded time base.

1.1.2.2 - OM 4512 galvanometer

This is a moving coil type instrument with low internal resistance, with external shunt damping for versions with low natural frequency, and oil damping for versions with higher natural frequencies.

The "pen" form of this galvanometer makes it possible to group up to 12 in one common magnetic block.

The nominal operating temperature range of the standard recorder is +20° to +30°C, using galvanometers type OM 4517/2, 3 and 6.

The OM 4502/1 version incorporates a magnetic block with which nominal values can be guaranteed over a recorder operating temperature range of 0 to +40°C, using galvanometers OM 4517/4 (1000 Hz), OM 4517/5 (1800 Hz) and OM 4517/7 (2500 Hz).

1.1.2.3 - OG 5507 event markers

Two electro-magnetic signal event markers (24 V - 12 mA) on marginal tracks, driven by contact closure, are used for sequence indexing. The event markers are remotely controlled (connector "RC"). One marker can be controlled locally, on a pushbutton mounted at the rear of the machine.

1.1.3 - Power supply

The recorder is designed to operate on a 115 - 130 - 230 - 245 V, 50/60 Hz source.

The recorder is powered from line supply, via a card located in the centre of the machine. Only the transformer is separate from this block, being located at the rear. This card supplies the voltages required for operation of the light sources, time base, switching logic, and amplifier supply unit. The motor is powered from line supply via a relay.

1.1.4 - Controls

The controls are grouped on a panel mounted on the top of the recorder. They comprise:

- General recorder on/off switch
- Motor on/off switch
- Selector for 4 basic paper speeds
- Selector giving two speeds (ratio 1:100), for each of the 4 basic speeds.
- Paper load pushbutton.

The last four controls act on the elements of the paper drive system, via a "switching logic" circuit.

The only control mounted on the rear panel, is the pushbutton for operation of one of the two electro-magnetic event markers.

1.1.5 - Trace identification device

This device provides cyclic interruption of the primary beam, the number of the galvanometer occulted being recorded in the margin.

This device can be cut out by the user.

1.1.6 - Galvanometer auxiliaries (optional)

1.1.6.1 - OM 4510 passive adaptors

These provide galvanometer attenuation, standardization, and damping. Three types are available:

- OM 4510/0

  For galvanometers with electro-magnetic damping.

- OM 4510/2

  For galvanometers with fluid damping.

- OM 4509/3

  Attenuator/HT adaptor for type OA 4571/0 and OM 4509/2 amplifiers (attenuation: 1/150 - 1/500).
  If the attenuator is employed with a type OA 4571/0 amplifier, only one measurement channel can be used.

- OM 4510/0

  Basic adaptor for special circuits (prepared by the user).

1.1.6.2 - Amplifiers for the OM 4502 recorder.

General

Plug-in amplifiers (max. 6) are connected at the rear of the recorder, in a nest provided for this purpose, via the OA 4572/0 power supply block. This block provides the voltages required for amplifier operation, from a line source.

Data input to the amplifiers is via connectors to standard DIN 41524.

Insertion of an amplifier in its recess, blanks off the direct inputs for the channel concerned.

1.1.6.3 - OA 4571/0 double amplifiers

In this case, two identical amplifiers are combined in the same card.

Each amplifier provides double isolation for the input circuits, and provides for galvanometer signal matching, without calculation of impedance or damping. The gain dynamic range, adjustable from 1 to

250, gives a maximum global sensitivity of 1 and 5 mV/cm with type OM 4517/2 and OM 4517/3 galvanometers.

These amplifiers can only be used with oil-damped galvanometers. Low is common for the two amplifiers.

1.1.6.4 - OM 4509/2 amplifier

Identical in its characteristics to the OA 4571/0 amplifier, the OM 4509/2 has only one amplifier per card.

1.1.6.5 - OM 4509/4 high input impedance amplifier

Identical in characteristics and presentation to the OM 4509/2, this version only differs by its input impedance value, this being 1 MΩ instead of 100 kΩ.

1.1.6.6 - OM 4509/0 amplifier

This has been replaced by the OM 4509/2, the only difference being gain dynamic range (1 to 120).

1.1.6.7 - OM 4509/1 amplifier for thermocouples

Identical in presentation to the OM 4509/0, this version provides immediate matching of signals from thermocouples, to electro-magnetical damped galvanometers.

Typical sensitivity is 50 µV/mm and bandwidth 35 Hz, using an OM 4517/0 galvanometer.

1.1.6.8 - OM 4509/3 auxiliary unit for strain-gauges

This auxiliary unit is designed specifically for association with strain-gauge bridge type devices (extensometry).

The OM 4509/3 provides:

- Double insulation of input circuits, and signal matching to the galvanometers (without calculation of damping or impedance).
- Strain-gauge power supply (2 to 8 V).

Gain dynamic range is adjustable from 1 to 50, giving maximum global sensitivity as indicated in the table below:

Strain-gauge bridge power supply	Galvanometer	Max. sensitivity
4 V	OM 4517/2 OM 4517/4	1.3 cm per mV/V or 1.10^{-3} $\frac{\Delta R}{R}$
	OM 4517/1	19 cm per mV/V or 1.10^{-3} $\frac{\Delta R}{R}$

1.1.6.9 - OA 4572/0 power supply block

Powered from a 24 V source provided by the recorder, this block provides power supply for:

- 6 type OA 4571/0 double amplifiers, or
- 6 type OM 4509/1, OM 4509/2 or OM 4509/4 amplifiers,
- 6 type OM 4509/3 auxiliary units,

or any combination corresponding to a total of 6 plug-in unit.

Reference voltage

The OA 4572/0 generates three reference voltages: 10 mV, 100 mV and 1000 mV, available on banana plugs, and used for amplifier calibration (square-wave signals). When used with only one channel, reference voltage accuracy is of $\pm$ 1%

1.1.6.10 - OM 4522/0 crystal-driven time base

The OM 4502 recorder is equipped with a standard time base, operating on 50 Hz line supply.

A crystal-driven time base has been developed, to allow utilization of the recorder at an alternative line frequency (60 Hz), or where source frequency is unstable (as in the case of certain DC/AC converters).

This option can be easily plugged in in place of the standard time base, and provides time base signals with a stability of 1.10^{-4} or better, over the temperature range 0 to +50°C.

1.1.6.11 - OM 4521/0 paper run time control unit

This accessory gives a choice of paper run time between 1 second and 10 minutes (24-position selector switch).

The time control unit is rectangular in form, and incorporates:

- 6-pin female Jaeger connector, for attachment to the recorder,
- 6-pin male Jaeger connector, for connection to the remote control unit.

The upper face of the unit carries a progressive time adjustment control (1 to 60 second steps), and a x 1/x 10 time selector.

1.1.6.12 - OM 4511/0 remote control unit

The operator can obtain the following functions, at a distance of up to 5 metres from the recorder:

- Motor start and stop,
- Selection of ratio (1 or 100) for the basic paper speed preselected on the control panel,
- Indexing of a sequence, by seperate control of the event markers incorporated in the recorder.

1.1.6.13 - OA 4573/0 paper take-up

This accessory provides take-up for the chart paper of the OM 4502 recorder, at paper speeds between 0.25 mm/s and 25 cm/s. The take-up is designed, in particular, for applications where substantial lengths of chart paper are used.

The take-up is mounted on the recorder in the factory, on request.

The part carrying the shaft (mounted on the recorder loading door), can be detached for easy transport of the machine, with the protective cover in place.

1.1.6.14 - OM 4524/0 rack-mounting adaptor

Used for mounting the recorder in a 19" standard rack.

1.1.6.15 - OM 4512/0 suspended cradle adaptor

Used for installation of the recorder on board an aircraft or vehicle.

1.1.6.16 - Access to the different elements

A rear door gives access to the UV lamp, and is also used for installation and adjustment of the galvanometers.

A loading door at the front of the recorder provides access to the paper magazine.

1.2 - Characteristics

1.2.1 - General characteristics

1.2.1.1 - Transport system

- Synchronized asynchronous motor
- Electro-magnetically controlled gearbox
- 8 paper speeds, selected by electrical switching, as follows:

Speed		(mm/s)		
Slow (ratio 1)	0.25	1	2.5	10
Fast (ratio 100)	25	100	250	1000

- Paper speed accuracy: better than 2%
- Speed change time from 10 to 1000 mm/s: < 0.1 s

Remote control

- Motor start and stop
- Ratio selection (1 or 100) for paper speed preselected on control panel
- 2 event markers.

Chart paper

- Direct daylight printing type, width 152 mm, specification A or 1 (emulsion face inwards).
- Capacity:
  - . 45 m standard 100 g/m2 grade
  - . 80 m thin 55 g/m2 grade.
- Schlumberger reference (1 roll):
  - . Standard paper: OA 4502/1 (45 m)
  - . High speed paper OA 4550/1 (45 m).

Ordinate axis:

- Every 2 mm, with heavier line every 10 mm.

OM 4515/0 time base

- Coded line on X-axis
- Rate: 0.01 - 0.1 - 1 - 10 s
- Selection: automatic, according to paper speed
- Driven from 50 Hz line source

OM 4522/0 crystal-driven time base (option)

- Coded line on X-axis
- Rate: 0.01 - 0.1 - 1 - 10 s
- Selection: automatic, according to paper speed
- Crystal-driven
- Stability: > 1.10^{-4} over temperature range 0 to +50°C.

Trace numbering discriminator

- Cyclic interruption of all spots, with marginal record of channel identification (number of galvanometer occulted). This system can be cut out.

Light sources

- OM 4519/0 HP mercury vapour lamp type 50 W3
  - . Constant power level
  - . Provides pin-hole beam for galvanometers, markers, and ordinate axis coding device.
- OM 4520/1 flashlamp:
  - . Driven from time base
  - . Time base flash source.
- 12-channel magnetic block

Recorder OM 4502/0	Block without thermostat control
Recorder OM 4502/1	Block with thermostat control

A switch is provided for cutting out the thermostatically controlled block heating system, for utilization of galvanometers not requiring this function.

- Power supply: 115 - 130 - 230 - 245 V, 50/60 Hz

- Consumption:

- With mercury vapour lamp on and paper running	No amplifier	160 VA max.
	With 6 double amplifiers	175 VA max.
+ thermostatically controlled block	With 6 double amplifiers	225 VA max.

1.2.2 - Mechanical characteristics

- Dimensions:

  . Length: 355 mm
  . Depth: 500 mm
  . Height: 160 mm

- Weight: 15 to 19 kg according to configuration.

1.2.3 - Measurement characteristics

EXAMPLES OF INPUT LEVELS

SENSITIVITY	AMPLIFIERS AND AUXILIARY UNITS		GALVANOMETERS	BANDWIDTH	APPLICATION
	IMPEDANCE	TYPE			
160 µV/cm to 8 mV/cm	35 kΩ	OM 4509/3	OM 4517/1	0 to 120 Hz	Physics
0.75 mV/cm to 37.5 mV/cm			OM 4517/2 OM 4517/4	0 to 600 Hz	Physics Electronics
1 mV/cm to 250 mV/cm	100 kΩ or 1 MΩ with	OM 4509/2 or OA 4571/0 or OM 4509/4	OM 4517/2 OM 4517/4	0 to 600 Hz	Electronics IRIG standard
			OM 4517/3 OM 4517/5	0 to 1 100 Hz	
4 mV/cm to 1.25 V/cm			OM 4517/6 OM 4517/7	0 to 1 500 Hz	
50 mV/cm to 10 V/cm	100 kΩ (1/50)	OM 4509/2 OM 4509/4 OA 4571/0* and OM 4510/3	OM 4517/2 OM 4517/4	0 to 600 Hz	Industrial electricity
0.5 V/cm to 100 V/cm	1 MΩ (1/500)	OM 4509/2 OM 4509/4 OA 4571/0* and OM 4510/3	OM 4517/2 OM 4517/4	0 to 600 Hz	Industrial electricity
0.8 V/cm to 8 V/cm	0.5 to 5 kΩ	OM 4510/2	OM 4517/2 OM 4517/4	0 to 600 Hz	Electro-mechanicals
3.3 V/cm to 33 V/cm			OM 4517/3 OM 4517/5	0 to 1 100 Hz	
			OM 4517/6 OM 4517/7	0 to 1 500 Hz	
40 µA/cm	1 kΩ	OM 4510/1	OM 4517/0	0 to 60 Hz	Schlumberger test transducers
20 mV/cm	0.5 kΩ				Power measurement on shunt
1 °C/cm to 120 °C/cm	100 kΩ	OM 4509/1	OM 4517/0 OM 4517/1	0 to 5 Hz (at — 3 dB)	Thermocouples
2,5 °C/cm to 300 °C/cm					
$1.10^{-4} \frac{\Delta R}{R}$ /cm $1.10^{-1} \frac{\Delta R}{R}$ /cm	35 kΩ	OM 4509/3	OM 4517/0 OM 4517/1 OM 4517/2 OM 4517/3 OM 4517/4 OM 4517/5	0 to 60 Hz ↓ 0 to 1 100 Hz	Strain gauge transducers Extensometry

*If an OM 4510/3 HT adaptor is associated with an OA 4571/0 double amplifier, only one of the amplifier channels can be used.

General recording characteristics

- Nominal deviation: ± 50 mm
- Trace definition: ≤ 0.4 mm
- Hysteresis:
  - . Typical: < 1%
  - . Guaranteed: < 2%
- Linearity:
  - . Typical: < 1%
  - . Guaranteed: < 2%

OM 4517 galvanometers (see chapter on "utilization", page 2.2)

OM 4517 GALVANOMETERS

Nom. range + 20°C to + 30°C	OM 4517/0	OM 4517/1	OM 4517/2	OM 4517/3	OM 4517/6
Nom. range 0°C to + 40°C	OM 4517/0	OM 4517/1	OM 4517/4	OM 4517/5	OM 4517/7
Frequency	100 Hz	200 Hz	1 000 Hz	1 800 Hz	2 500 Hz
Identification	Red	Yellow	Black	Green	Red, green, red
Internal resistance	60 Ω	65 Ω	70 Ω	62 Ω	80 Ω
Sensitivity coefficient	25 µA/cm	70 µA/cm	1,65 mA/cm	6,65 mA/cm	10,5 mA/cm
Max. current	10 mA	10 mA	50 mA	50 mA	50 mA
Recommended deviation	± 5 cm	± 5 cm	± 5 cm	± 5 cm	± 3,8 cm
Effective deviation	± 7,5 cm	± 7,5 cm	± 7,5 cm	± 6 cm	± 4 cm
Bandwidth at 10 %	60 Hz	120 Hz	600 Hz	1 100 Hz	1 500 Hz
Damping	Electro-magnetic 120 Ω external shunt		Oil		

NOTE: Galvanometers marked ✱ are designed for use with magnetic blocks thermostatically controlled at a temperature of +50°C.

Event markers

- Contact-closure operation
- Powered from recorder 24 V source (12 mA max.).
- Local pushbutton control of 1 event marker.

Direct inputs

On 4 mm banana plugs

- Insulation between channels:
  - . with respect to ground: > 500 MΩ at 100 V DC
- Max. voltage:
  - . between channels: 100 V rms, 50 Hz
  - . with respect to ground: 220 V rms, 50 Hz.

OM 4571/0 amplifier (galvanometers with fluid damping)

- Double insulation between channels, and between channels and recorder ground, insulation resistance:	> 500 MΩ at 100 V DC
- Common mode voltage:	220 V rms, 50 Hz
- Common mode rejection:	≥ 100 dB 50 Hz sine-wave
- Input impedance:	100 kΩ
- Differential input capacitance:	< 50 pF
- Input capacitance with respect to shield:	< 100 pF
- Shield capacitance with respect to recorder ground:	< 100 pF
- Max. input voltage:	20 V
- Max. guaranteed slope:	1.85 mA/mV
- Guaranteed gain dynamic range:	x 250

- . Adjustable in x 1 x 2 x 5 x 10 x 20 and x 50 steps
  overlay accuracy: better than 2%
- . Progressive adjustment from x 1 to ≥ 5

- Linearity:	error ≤ 0.5%
- Output current (68Ω load):	
. Guaranteed linear range:	± 40 mA
. Saturation:	≤ ± 55 mA

- Bandwidth (68Ω load) 0 to -5%:

Better than 0 to 2000 Hz for these configurations	x 1	x 1 to x 5
	x 2	x 1 to x 5
	x 5	x 1 to x 5
	x 10	x 1 to x 5
	x 20	x 1 to x 2.5
	x 50	x 1 to x 1.5

other configurations: better than 0 to 1000 Hz

- Temperature stability at input (temperature range 25°C ± 20°C):
  - . Zero: ≤ 40 µV/°C Rin = 1 kΩ
  - . Slope: ≤ 100 ppm/°C
- Noise at input: < 10 µV rms, from 0 to 10 kHz
- Connection: DIN 41524 standard 3-pin connector, supplied with 2 m connecting lead.

Differential capacitance: approx. 100 pF.
Capacitance of each wire with respect to shield: approx. 200 pF.

Amplifier OM 4509/2

Same characteristics as the OM 4571/0, but with one amplifier only per double-card.
Incorporates accessible zero adjustment.

High input impedance amplifier IM 4509/4

Identical in presentation and characteristics to the OM 4509/2, except that input impedance is 1 MΩ instead of 100 kΩ.

Thermocouple amplifier OM 4509/1

- Input impedance: 100 kΩ
- Max. input drift: 10 µV/°C with Rout < 100Ω
- Max. output current: ± 4 mA linear, saturation < ± 6 mA
- Noise at input: < 10 µV rms, from 0 to 10 Hz

Galvanometer	Sensitivity adjustment range	Bandwidth (-3 dB)	Attenuation (50 Hz)
OM 4517/0	50 µV/cm to 5 mV/cm	0 to 5/7 Hz	-36 dB to -16 dB
OM 4517/1	150 µV/cm to 15 mV/cm		

Strain-gauge auxiliary unit OM 4509/3

- Double insulation of inputs and bridge power supply: between different auxiliary units with respect to recorder ground, insulation resistance: > 500 MΩ at 100 V DC
- Max. common mode voltage: 220 V rms, 50 Hz
- Common mode rejection: ≥ 100 dB at 50 Hz, sine-wave
- Strain-gauge bridge power supply voltage: Adjustable from 2 to 8 V, outp current 40 mA
  - . Temperature stability: Better than 250 ppm/°C
  - . Stability with respect to recorder power supply voltage: < 0.1% for ± 10% line voltag deviation.

Characteristics of differential amplifier

- Differential input impedance: 34.8 kΩ
- Differential input capacitance: < 100 pF
- Input capacitance with respect to shield: < 100 pF
- Shield capacitance with respect to recorder ground: < 100 pF
- Max. differential input voltage: 100 V DC
- Max. input voltage with respect to power supply 0 V: 15 V DC
- Max. slope: 2.16 mA/mV
- Gain dynamic range: 50, in x1, x2, x5, x10, x20 and x50 steps
  - . Overlay accuracy: Better than 2%
- Linearity: Error ≤ 0.5%

- Output current:

  . With fluid damped galvanometers (oil): linear: 40 mA
  saturation: ≤ 55 mA

  . With electro-magnetically damped galvanometers: linear: 6 mA
  saturation: ≤ 10 mA

- Minimum bandwidth (80Ω load), to -5%

x 1	0 to 10 kHz
x 2	0 to 7 kHz
x 5	0 to 4 kHz
x 10	0 to 3 kHz
x 20	0 to 2 kHz
x 50	0 to 1 kHz

- Temperature stability at input:

  . Zero: ≤ 5 µV/°C

  . Slope: ≤ 100 ppm/°C

- Noise at input: ≤ 10 µV rms, 0 to 10 kHz

- Balancing/calibration:

  . Adjustment by steps: $\pm 5 \quad \pm 4 \quad \pm 3 \quad \pm 2 \quad \pm 1 \quad 0 \quad 10^{-3} \quad \frac{\Delta R}{R}$

  . Step accuracy: better than 1%

  . Progressive adjustment: $\pm 1.2 \times 10^{-3} \quad \frac{\Delta R}{R}$

- Utilization: half-bridge with internal network incorporating two 500 Ω resistors

  . ratio of 2 resistors: 1 ± 10^{-3}

  Connection: DIN 4152N standard 5-pin connector, supplied with 2 m connecting cable.

Paper run time control unit OM 4521/0

- Paper run time: Steps of 1 - 2.5 - 5 - 7.5 - 10 - 15 20 - 25 - 30 - 40 - 50 - 60 seconds, with x 1 and x 10 multiplication selector.

- Paper run time accuracy: ± 10% of selected time ± 0.2 s.

Power supply OA 4572/0

This unit powers:

- 6 type OA 4571/0 double amplifiers, or
- 6 type OM 4509/2, OM 4509/1 or OM 4509/4 amplifiers, or
- 6 type OM 4509/3 auxiliary units, or any combination giving a maximum total of 6 cards.

This power supply can be used to check the mechanical zero of the galvanometers, by cutting out supply to all amplifiers by means of a reversing switch.

This power supply also produces reference voltages of 10, 100 and 1000 mV with an accuracy of ± 1%, when used with one measurement channel.

Adaptors

These provide galvanometer attenuation, standardization or damping.

OM 4510/1

For galvanometers with electro-magnetic damping (see table of input levels, page 1.12).

OM 4510/2

For galvanometers with oil damping (see table of input levels, page 1.12)

OM 4510/3

Attenuator/HT adaptor for amplifier OM 4509/0:

- Attenuation: 1/50 1/500
  input resistance ± 1%: 100 kΩ 1 MΩ
- Max. voltage at input: 500 V.

OM 4510/0

Basic adaptor for special circuits.

Remote control

The remote control unit covers the following functions:

- Chart paper drive start/stop

- Paper speed multiplication factor selection (x 1 or x 100)
- Control of 2 event markers.

1.2.4 - Electrical connections

12-channel measurement input

- Direct (with adaptors): 4mm banana sockets,19 mm spacing
- With amplifiers: Two wires screened input leads,supplied with each amplifier.Lead length 2 m,fitted with DIN 41524.3pin male connector for OM 4509/ 0 , /1 ,/2 , /4 ,5pin connector for OA 4571/0.
- With amplifiers OM 4509/3: Screened input leads supplied with each amplifier. Lead length 2 m, fitted with DIN 41524 5-pin male connector.

24 V output

- Banana sockets, for power supply to transducer auxiliaries. 2 outputs in parzllel (24 V - 150 mA).

Reference voltage output

- 4 mm banana sockets.

1.2.5 - Accessories

Remote control unit OM 4511/0

- Unit in separate housing
- Lead length 5 m.

Rack-mounting adaptor OM 4524/0

- Slide cradle
- Dimensions:
  - . Width: 19"
  - . Height: 4 U
  - . Effective cabinet depth: 420 to 550 mm.

Airborne adaptor OM 4512/0

- Suspended cradle
- Dimensions: 570 mm x 235 mm x 115 mm (without shock-mounts)

For operation of the recorder under the following conditions:

- Vibrations:
  - . Constant amplitude: 0.16 mm from 20 to 78 Hz
  - . Constant acceleration: 20 m/s^2 from 78 to 500 Hz.
- Endurance test: 25 m/s^2 for 2 hours, at 50 Hz.

Accessories case OM 4513/0

Fitted with pull-out compartments, and taking:

- Operating manual
- 3 boxes, each containing 1 roll of chart paper
- 18 galvanometers in separate case
- 3 spare lamps in separate case
- Remote control unit
- Leads and accessories.

Dimensions: 400 x 130 x 350 mm.

UTILIZATION

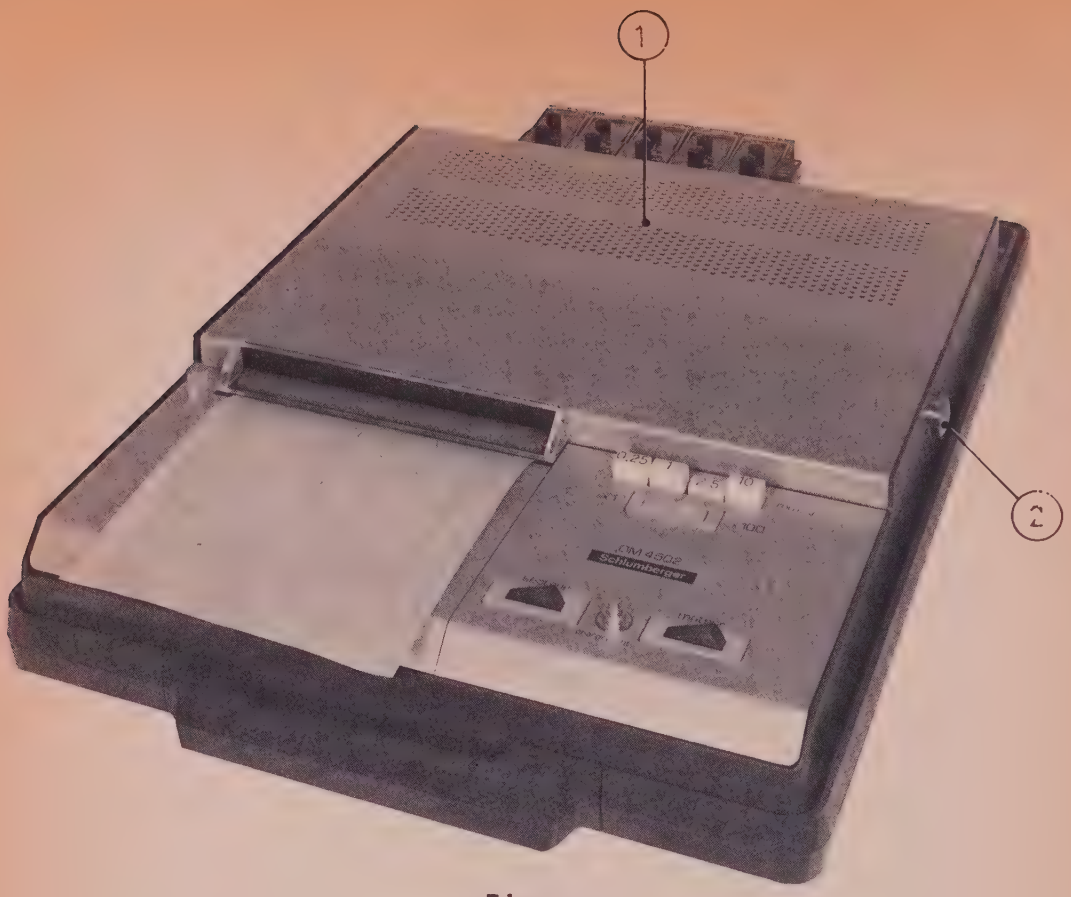


Fig. 1

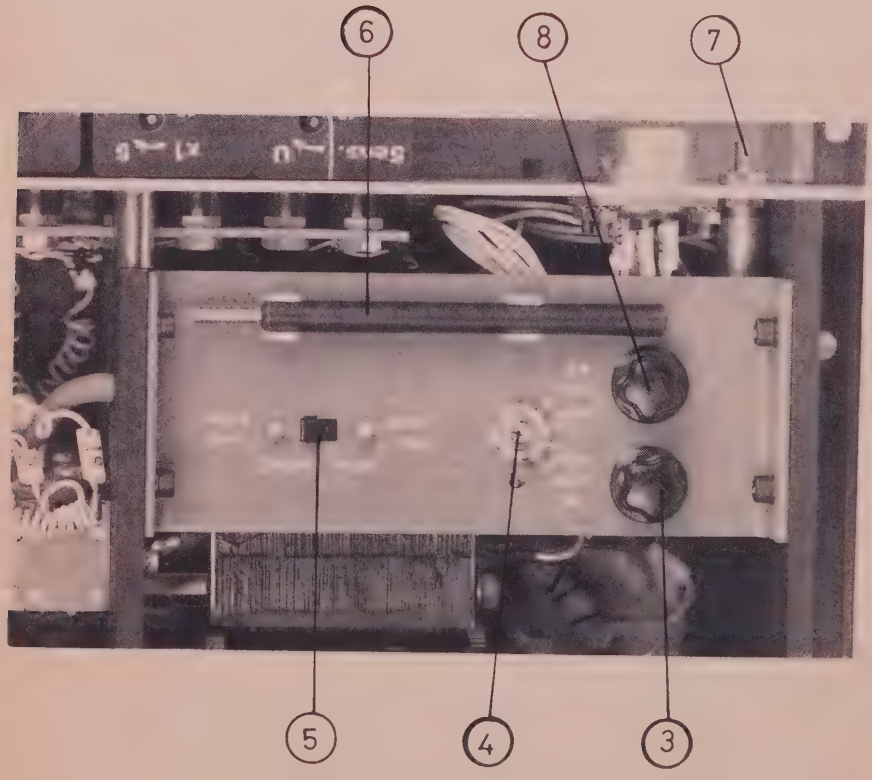


Fig. 2

2 - PREPARATION FOR USE - UTILIZATION

PRELIMINARY NOTE: To remove the upper cover, depress the 2 lateral lock buttons simultaneously (fig. 1, index 2), and lift the cover off.

2.1 - Line power supply

Check that the line voltage selector (fig. 2, index 4) is in the correct position for the line source voltage used.

The power supply circuit is protected by a 2 A fuse (fig. 2, index 8).

The thermostatically controlled magnetic block heating circuit is protected by a 1 A fuse (fig. 2, index 3).

In the case of recorder version OM 4502/1, this heating circuit can be cut out by operating the appropriate switch (fig. 2, index 5). In the case of recorder version OM 4502/0 the switch is inoperative.

2.2 - Preparation for use

Before operating the recorder, the following elements must be placed in position (with the recorder not yet connected to line power supply):

- Galvanometers
- Adaptors, amplifiers and auxiliary units
- Paper run time control unit, where applicable.

Refer to page 2.2 onwards, for determination of the types of galvanometer, amplifier, and auxiliary unit to be used.

NOTE

The OA 4572/0 power supply unit can supply:

6 type OA 4571/0 double amplifiers (12 measurement channels), or
6 type OM 4509/1, 2 or 4 amplifiers (6 measurement channels), or
6 type OM 4509/3 auxiliary units, or any possible combination of these options.

When an amplifier or auxiliary unit is plugged in, this cuts out direct input for the corresponding channel.

2.3 - Selection of galvanometers and auxiliaries (fig. 3)

2.3.1 - General

The "pen" type galvanometers used in the OM 4502 UV recorder are of the moving coil type.

A mirror placed behind a flat/spherical lens is integral with a moving coil, the assembly being held in position by means of suspension wires.

This assembly is placed in a magnetic field (0.975 Tesla), produced by two permanent magnets.

To obtain the desired performance characteristics - hight natural frequency and sensitivity - a judicious compromise has been made between the inertial moment of the moving coil assembly, and the active surface of the coil.

2.3.2 - Galvanometer damping

To obtain optimum bandwidth characteristics, a flat frequency response (-3 dB) has been selected, this giving a reduced damping factor of 0.64 for a second degree system (the galvanometers corresponding to this category).

This factor is obtained:

- either by means of an adequate resistance external to the galvanometer, in the case of galvanometers with electro-magnetic damping.

Internal frequency, to ± 5%	100 Hz	200 Hz	1000 Hz		1800 Hz		2500 Hz	
IDENTIFICATION	Red	Yellow	Black	Red (heated galva.)	Green	Red (heated galva.)	Red Green Red	Gold / Rhodium (heated galva.)
S.I.S. Ref.	OM 4517/0	OM 4517/1	OM 4517/2	OM 4517/4	OM 4517/3	OM 4517/5	OM 4517/6	OM 4517/7
Coil resistance, to ± 10%	60Ω	63Ω	70Ω		62Ω		80Ω	
Damping	Electro-magnetic R// optimum 120 Ω		Oil R// 200Ω					
Sensitivity With 200 mm, to ± 5%	Galva. only: 25 µA/cm | 70 µA/cm Damped galva.: 325µA/cm | 111 µA/cm		1.65 mA/cm		6.65 mA/cm		10.5 mA/cm	
Max. recommended elongation for the OM 4501	± 5 cm						± 4 cm	
Bandwidth, to ± 5%	60 Hz	120 Hz	600 Hz		1100 Hz		1300 Hz	
Max. current	10 mA		50 mA					

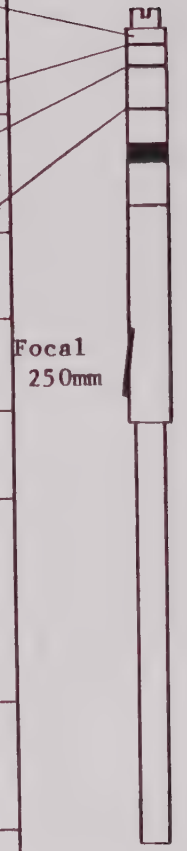


Fig. 3

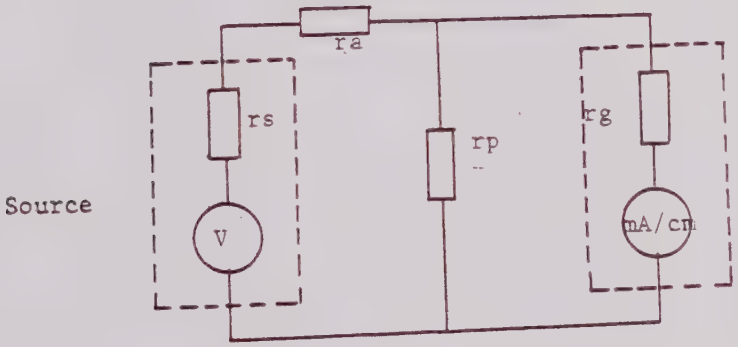
- or by correct heating of the galvanometers, in the case of fluid-damped versions (silicon oil).

2.3.3 - Deflection zones

In order to minimize recording errors, it is advisable to ensure that deflection of each spot is limited to a predetermined sweep zone (see fig. 4). We are concerned here with tangential errors due to the fact that deflection is proportional to $tg\alpha$, α being the angle of rotation of the mirror.

2.3.4 - Utilization of galvanometers with adaptor circuits

2.3.4.1 - General case



$$ra = \frac{V.\ R.\ 10^3}{I\ \delta\ (rg+R)} - rs$$

$$rp = \frac{R\ (rs + ra)}{rs + ra - R}$$

With:

I = Galvanometer sensitivity in mA/cm

δ = Desired elongation, in cm

R = Optimum galvanometer damping resistance

V = Voltage to be measured in Volts

rg = Galvanometer resistance

rs = Source resistance

rp = Resistance in parallel with the galvanometer

ra = Attenuator series resistance.

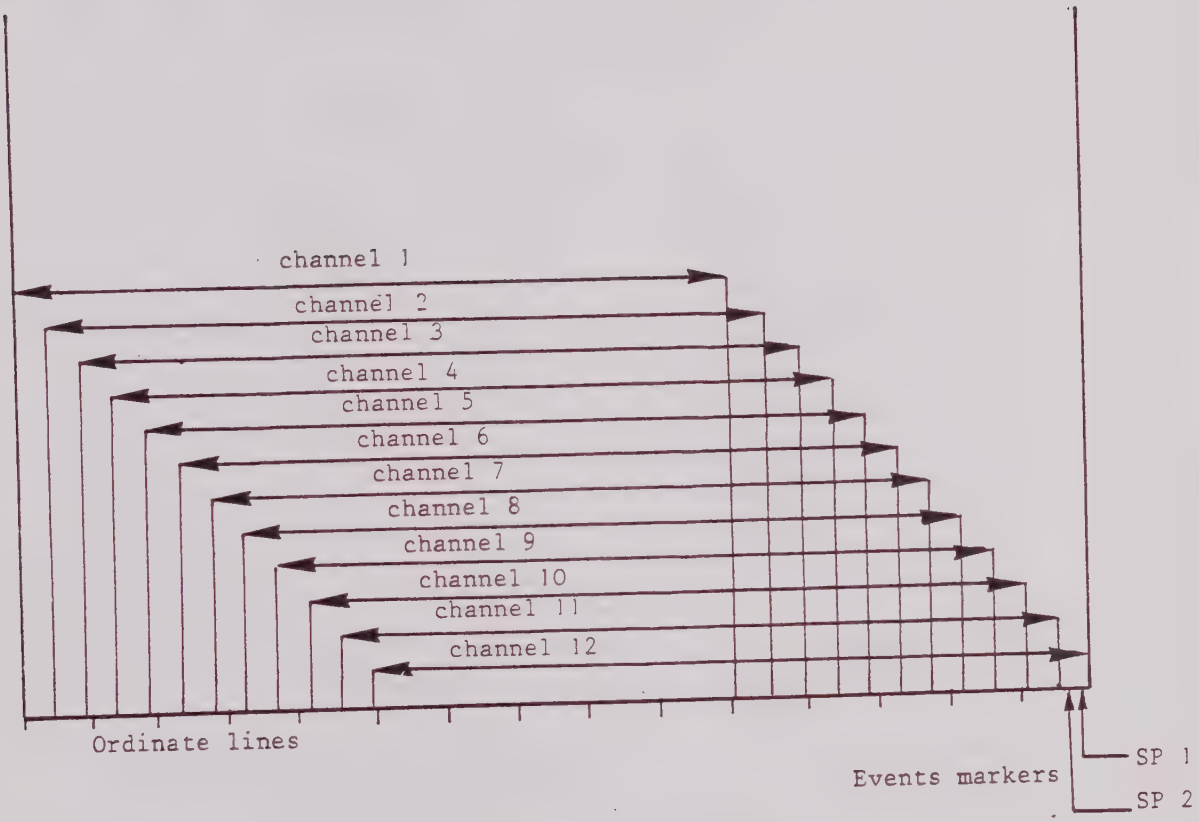

channel 1
channel 2
channel 3
channel 4
channel 5
channel 6
channel 7
channel 8
channel 9
channel 10
channel 11
channel 12
Ordinate lines
Events markers
SP 1
SP 2

Fig.4

2.3.4.2 - Galvanometers with electro-magnetic damping

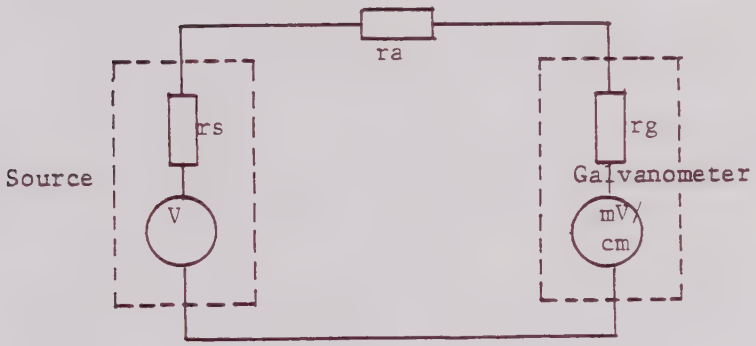
Use the equations giving ra and rp.

2.3.4.3 - Galvanometers with fluid damping

The equation reduces to:

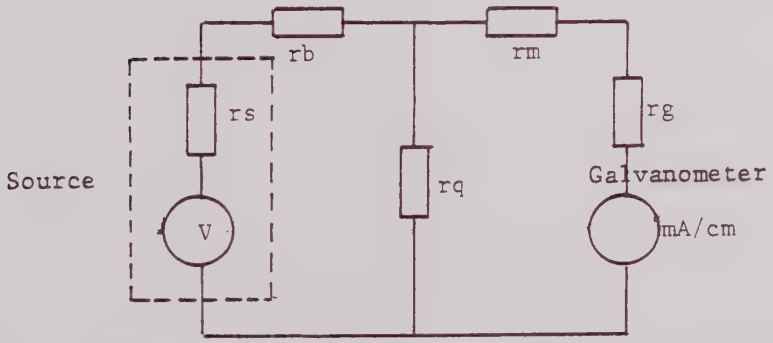
$$ra = \frac{V \cdot 10^3}{I \cdot \delta} - (rs + rg)$$

$$rp = \infty$$



If greater attenuation is required, the arrangement shown in the general figure can be adopted, with $R \geq 120\ \Omega$

Use the following arrangement:



$$K = \frac{I \cdot \delta \cdot 10^3 \ (rs + ri)}{V}$$

with Ri = load resistance (source end).

giving:

$$rq = K\,(rg + R)\cdot\frac{1}{1 - K^2\cdot\frac{rg + R}{Ri + rs}}$$

$$rb = Ri - (1 - K)\,rq$$

$$rm = \left(\frac{I}{K} - 1\right) rq - rg$$

2.4 - Utilization of galvanometers with type OA 4571/0, OM 4509/2 and OM 4509/4 amplifiers

These amplifiers can only be used with oil-damped galvanometers.

This is the safest and most convenient method for using this type of galvanometer, which is thus protected against overloads.

Refer to figs. 4 and 5 for selection of galvanometer and amplifier gain, according to the following two parameters:

- Frequency band: 0 to 600 Hz, 0 to 1100 Hz, or 0 to 1600 Hz
- Sensitivity: cm/mV, cm/V... and mV/cm, V/cm.

To measure amplitude to within ± 1%, ensure that a maximum elongation of ± 5 cm is not exceeded.

Electro-magnetically damped galvanometers cannot be used with type OA 4571/0, OM 4509/2 or OM 4509/4 amplifiers.

- firstly there is a risk of destruction resulting from over-current,
- secondly, these galvanometers would be "non-damped", thus with theoretically infinite overrange of their natural frequency. Furthermore, in this case the galvanometers can be made to operate in fields where amplifier thermal drift has a value approaching that of the phenomena to be measured.

2.5 - Utilization of galvanometers with type OM 4509/1 amplifiers for thermocouples

Type OM 4509/1 amplifiers are designed particularly for thermocouple measurement.

They can only be used with electro-magnetically damped galvanometers, with the 120 Ω galvanometer damping resistance incorporated in the amplifiers.

With this type of measurement, firstly sensitivity is high, and secondly the signal is frequently perturbed by a component at line frequency.

AMPLIFIER OM 4509/2 Selector position	Bandwidth (GALVANOME Progressive adj.
1	min. max.
2	min. max.
5	min. max.
10	min. max.
20	min. max.
50	min. max.
Max. elongation	Recommended Admissible

° Bandwidt

A Heated g

5")	0 - 600 Hz		0 to 1100 Hz °		0 to 1500 Hz °	
R Fo Type	1000 Hz OM 4517/2 OM 4517/4[A]		1800 Hz OM 4517/3 OM 4517/5		2500 Hz OM 4517/6 OM 4517/7	
	223 mV/cm to 44.6 mV/cm	4.5 cm/V to 22.4 cm/V	0.9 V/cm to 0.18 V/cm	1.1 cm/V to 5.6 cm/V	1.42 V/cm to 0.28 V/cm	0.7 cm/V to 3.5 cm/V
	111 mV/cm to 22.3 mV/cm	0.09 mm/mV to 0.45 mm/mV	449 mV/cm to 89 mV/cm	2.2 cm/V to 11.1 cm/V	0.71 V/cm to 0.15 V/cm	1.4 cm/V to 7 cm/V
	44.6 mV/cm to 8.9 mV/cm	0.22 mm/mV to 1.12 mm/mV	180 mV/cm to 35.9 mV/cm	0.05 mm/mV to 0.28 mm/mV	284 mV/cm to 56.7 mV/cm	3.5 cm/V to 18 cm/V
	22.3 mV/cm to 4.46 mV/cm	0.45 mm/mV to 2.24 mm/mV	8.9 mV/cm to 18 mV/cm	0.11 mm/mV to 0.56 mm/mV	142 mV/cm to 28.4 mV/cm	0.07 mm/mV to 0.35 mm/mV
	11.1 mV/cm to 2.23 mV/cm	0.9 mm/mV to 4.48 mm/mV	44.9 mV/cm to 8.9 mV/cm	0.22 mm/mV to 1.11 mm/mV	71 mV/cm to 14.2 mV/cm	0.14 mm/mV to 0.7 mm/mV
	4.46 mV/cm to 0.89 mV/cm	0.22 cm/mV to 1.12 cm/mV	18 mV/cm to 3.59 cm/mV	0.55 mm/mV to 2.8 mm/mV	28.4 mV/cm to 5.67 mV/cm	0.35 mm/mV to 1.76 mm/mV
	± 5 cm ± 7.5 cm		± 5 cm ± 6 cm		± 3.8 cm ± 4 cm	

limited to 1000 Hz when max.gain amplifiers used.

vanometers used in a magnetic assembly thermostatically controlled at 50 ° C

Fig 5

AMPLIFIER OM 4509/1 / GALVANOMETER Type		OM 4517/0		OM 4517/1		Band-width (-3 dB)	Attenuation (50 Hz)
Selector position	Progressive adjustment						
x 1	Min.	58 µV/cm to 4.7 µV/cm	1.72 mm/mV to 21 mm/mV	16 mV/cm to 1.3 mV/cm	0.62 mm/mV to 7.6 mm/mV	0-7 Hz	-16 dB
	Max.					0-6 Hz	-24 dB
x 10	Min.	58 µV/mm to 4.7 µV/mm	1.72 mm/100 µV to 21 mm/100 µV	1.6 mV/cm to 0.13 mV/cm	6.2 mm/mV to 7.6 mm/mV	0-6 Hz	-18 dB
	Max.					0-3 Hz	-36 dB
Max. elongation	Recommended	± 5 cm					
	Admissible	± 7.5 cm					

Fig. 6 - UTILIZATION OF GALVANOMETERS WITH TYPE OM 4509/1 AMPLIFIERS

This component produces spot thickening. Amplifier thermal drift falsifies measurement, and a value of 50 µV/mm should not be exceeded.

- Spurious components frequently make it necessary to connect amplifier low to recorder ground, in order to reduce the spot thickening phenomenon, this nevertheless having the disadvantage of cancelling double insulation.

Refer to fig. 6 for choice of galvanometer and amplifier gain.

2.6 - Utilization of galvanometers with type OM 4509/3 auxiliary units

The OM 4509/3 auxiliary unit can be used with all types of OM 4519 galvanometer.

The auxiliary unit ensures correct operation, and protection against galvanometer overload, provided the "GALVA DAMPER" switch (fig. 14, index 5), is placed in the correct position, namely:

Bandwidth at ± 5%	0 - 60 Hz		0 - 120 Hz		0 - 600 Hz		0 - 1100 Hz		0 - 1500 Hz	
Galvanometer Fo	100 Hz		200 Hz		1000 Hz		1800 Hz		2500 Hz	
Conditioner OM 4509/3 Type	OM 4517/0		OM 4517/1		OM 4517/2 OM 4517/4 *		OM 4517/3 OM 4517/5 *		OM 4517/6 OM 4517/7 *	
Switching step										
1	2,8 mV/cm	0,36 cm/mV	8 mV/cm	0,125 cm/mV	3,75 mV/mm	0,26 mm/mV	15,6 mV/mm	0,064 mm/mV	2,5 mV/mm	0,04 mm/mV
2	1,4 mV/cm	0,72 cm/mV	4 mV/cm	0,25 cm/mV	1,875 mV/mm	0,52 mm/mV	7,8 mV/mm	0,128 mm/mV	12,5 mV/mm	0,08 mm/mV
5	0,56 mV/cm	1,8 cm/mV	1,6 mV/cm	0,625 cm/mV	0,75 mV/mm	1,3 mm/mV	3,1 mV/mm	0,32 mm/mV	5 mV/mm	0,2 mm/mV
10	280 µV/cm	3,6 cm/mV	0,8 mV/cm	1,25 cm/mV	3,75 mV/cm	2,6 mm/mV	1,56 mV/mm	0,64 mm/mV	2,5 mV/mm	0,4 mm/mV
20	140 µV/cm	7,2 cm/mV	400 µV/cm	2,5 cm/mV	1,87 mV/cm	5,2 mm/mV	0,78 mV/mm	1,28 mm/mV	1,25 mV/mm	0,8 mm/mV
50	56 µV/cm	18 cm/mV	160 µV/cm	6,25 cm/mV	0,75 mV/cm	13,4 mm/mV	0,31 mV/mV	3,2 mm/mV	0,5 mV/mm	2 mm/mV
Max. elongation Recommended	± 5 cm		± 5 cm		± 5 cm		± 5 cm		± 3,8 cm	
Max. elongation Usable	± 7,5 cm		± 7,5 cm		± 7,5 cm		± 6 cm		± 4 cm	

Hatched zones : These zones must be avoided, due to the high sensitivity because power frequency interference leads to trace thickening.

Heated galvanometers used with a magnetic assembly thermostatically controlled to +50 °C.

Fig.7

- "EM" for OM 4517/0 and OM 4517/1
- "Oil" for all other types.

When these modules are used in the differential amplifier mode, reference should be made to fig. 7, for choice of galvanometer according to bandwidth and sensitivity.

If the OM 4509/3 is used as a strain-gauge auxiliary unit, the following calculation must be made to determine the sensitivity value to be used (see also § 2.8.5.1.):

- $m = mV/V$ /unit of physical value to be measured
- $n = 10^{-3} \frac{\Delta R}{R}$ /unit of physical value to be measured

so that:

$$e = \frac{U \cdot m}{\frac{U}{4} \cdot n}$$

With U the strain-gauge power supply voltage.

According to the variation of the physical value to be measured, we calculate m or n, followed by e, then referring to the table in fig. 7, for choice of galvanometer according to bandwidth and sensitivity ($\frac{mV}{Cm}$ or $\frac{Cm}{mV}$).

2.7 - Installation of galvanometers and auxiliaries

2.7.1 - Installation of galvanometers (fig. 8)

Hold the galvanometer by the coded end (coloured spot or ring, large diameter end, screwdriver slot), and insert the other end on a slant (at an angle of approx. 45°), in the recess in the magnetic block. The mirror is positioned on the opposite side to the contact pins.

Straighten the galvanometer and insert fully. Avoid any undue transverse effort.

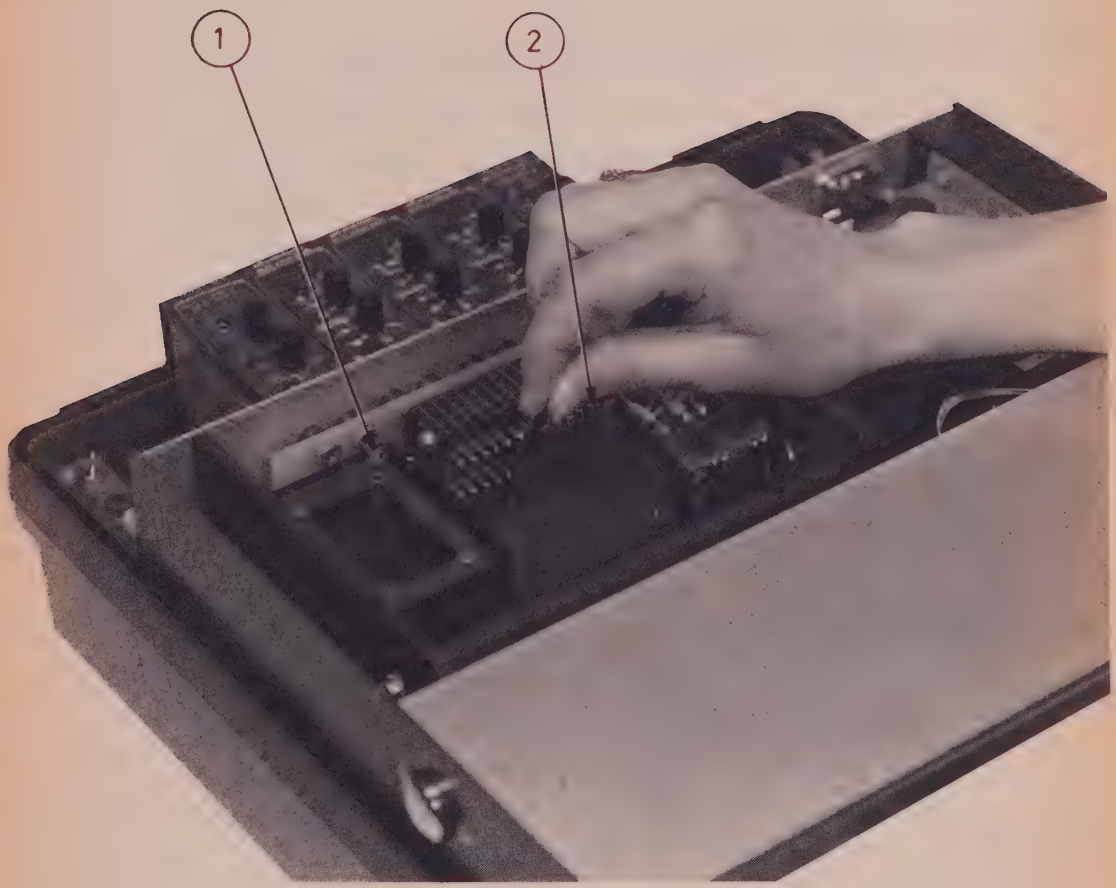


Fig 8

2.7.2 - Fitting the adaptors

The adaptors plug into the rear of the unit, in the parameter direct input sockets on the vertical panel. They should be so positioned that adjustments "P" and "S" are easily accessible.

2.7.3 - Fitting the amplifier power supply (Option 0A 4572/0)

With the lower cover removed, and the instrument turned over on its back, fit the power supply unit, attaching same by means of the screws provided. These screws must be fixed via the top of the recorder. Place the connector in position (fig. 24, index 8), and replace the lower cover.

2.7.4 - Fitting amplifiers and auxiliary units

Amplifiers and auxiliary units are inserted in a nest provided for this purpose at the rear of the recorder. They plug into a power supply block incorporating miniature banana sockets. Position the amplifier so that the measurement lead can be connected to the input connector.

2.7.5 - Inserting the OM 4515/1 time base (option) or OM 4522/0 crystal-driven time base card

- Undo retainer screws (fig. 19, index 16).
- Remove cover plate (fig. 19, index 15), and turn the locking devices (fig. 20, index 10).
- Insert the card on the slant, push fully home into the connector, and lock in position by straightening.
- Replace the cover plate.

2.7.6 - Fitting the flash lamp (fig. 24)

Turn the recorder over onto its back, and undo the two retainer screws for the lower cover, removing the latter. With the metallized surface facing the epoxy glass support, place the lamp in the attachment clips with extreme care, ensuring that the long wire of the lamp is on the right, when facing the recorder from the front and with the handle towards the operator.

Make the two connections. Ensure that the connecting wires do not block the light apertures.

The wire from the striking electrode (middle of 8) must be soldered (60/40 tin/lead) to the middle terminal.

2.7.7 - Identification of input connections

Direct input (banana sockets on rear panel):

1 - A positive signal applied to the upper terminal deflects the spot in a positive direction (to operator's right, facing the display window).

Input to amplifiers and auxiliary units:

2 - Connection of the input socket to the auxiliary units is shown in the appropriate diagram.

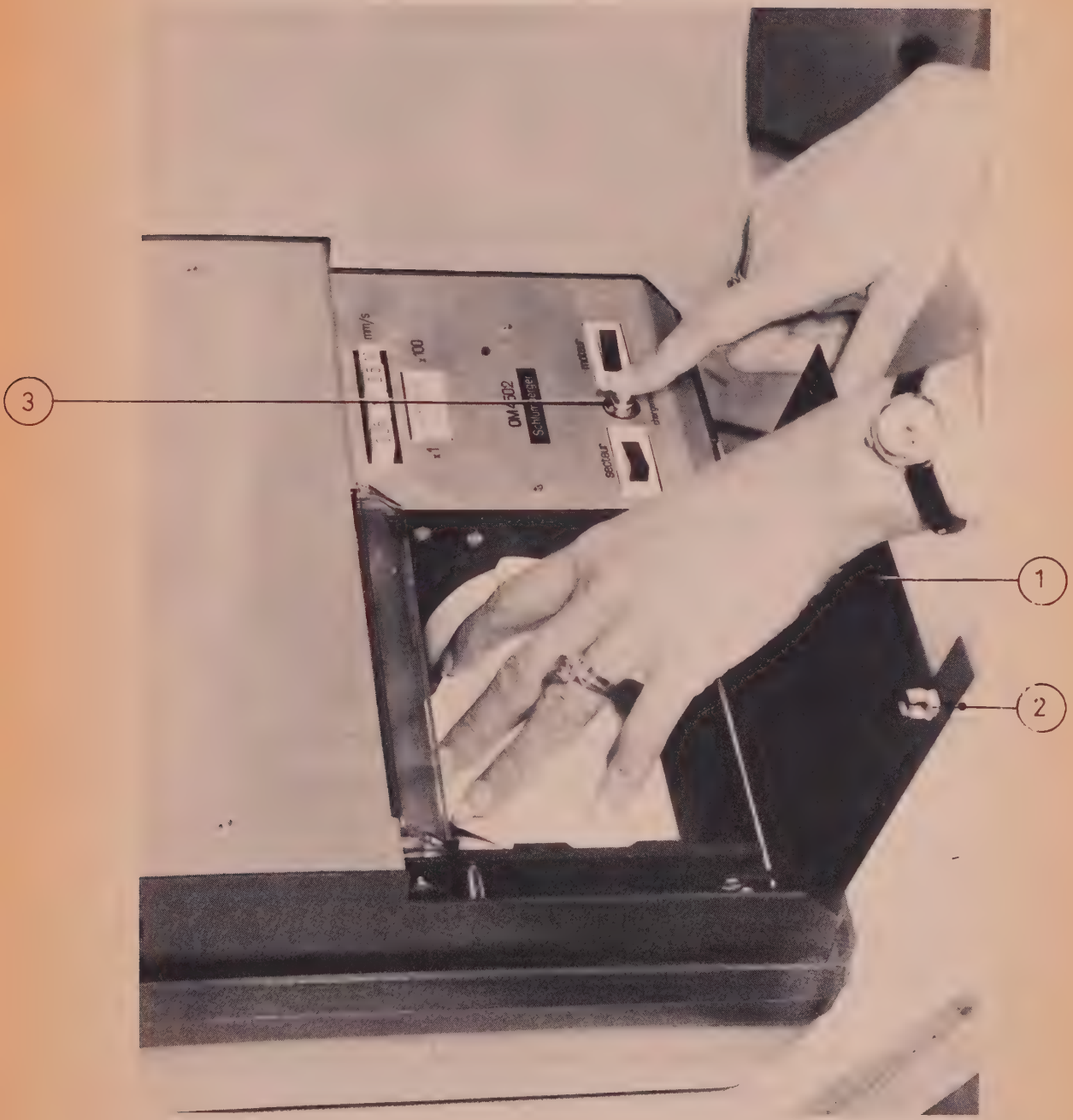


Fig 9

2.7.8 - Ground points available

The various channels, with or without amplifiers, are isolated from each other. The following ground points are available:

General recorder ground

Mechanical ground connected to the black terminals of the 24 V power supply, and to the red terminal of the reference sources.

Shield (amplifier guard)

Input lead braid: the shield is coated with epoxy paint, providing operator protection in cases where the measurement value involves a high common mode voltage. This paint coating must not be destroyed.

NOTE: A connection between amplifier guard and recorder ground cancels this safety system.

2.7.9 - Loading the paper

Switch the recorder on.

The mercury vapour lamp comes on, reaching normal operating conditions after a warm-up period of about 1 minute.

This interval can be used for loading the paper. Proceed as follows:

- Open the trap giving access to the paper magazine (fig. 9, index 1), using the access trap release button (fig. 9, index 2).

- Insert the shaft in a roll of chart paper, and replace same in the magazine so that for normal paper drive direction, the sensitized surface of the paper is presented to the UV rays (fig. 10).

- Feed the paper under the drive roller, having first folded back both corners of the roll end.

- Guide the paper with the thumb and third finger of the left hand, pushing same with the index finger. Depress the loading button with the right hand (fig. 9, index 1).
- Release the loading button as soon as the paper emerges.

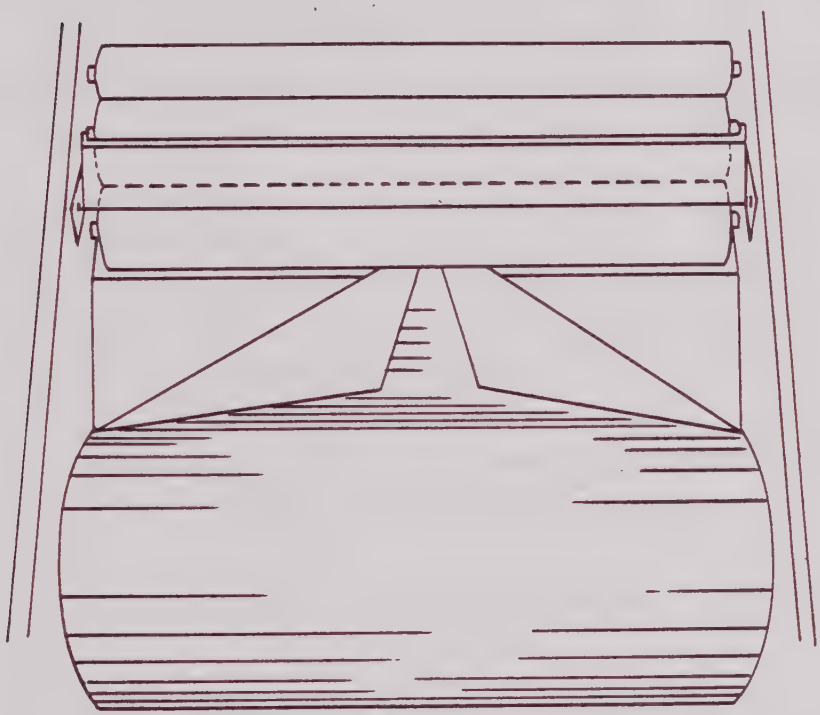


Figure 10

2.8 - Adjustments

2.8.1 - Adjusting the mercury vapour lamp

Allow the mercury vapour lamp to stabilize, then operating the height adjustment screw (fig. 8 , index 1), until the beam appears on the galvanometer focusing lenses.

For this purpose, place a strip of paper in front of the lenses, resting the end of the slip on the magnetic block. The beam should illuminate the bottom of the strip.

If the beam is already present, undo the adjustment screw so as to make the beam disappear downwards, and repeat the adjustment in the opposite direction. Stop turning the screw as soon as the

whole beam appears at full brightness.

NOTE: 1 - If line supply is accidentally cut, the mercury vapour lamp will come on again immediately provided the interruption does not last more than 0.2 seconds. If the interruption lasts longer than 0.2 seconds, the lamp will only come on again after an interval of 1 minute.

2 - The beam must not be set too high, otherwise this results in stray light liable to cloud the paper.

2.8.2 - Discriminator

The spots are interrupted cyclically every 10 cm of paper. Each time a spot is occulted, the corresponding channel number is written in the left margin of the paper.

Where a continuous, uninterrupted trace is desired (recording of erratic pulses for example), the discriminator can be cut out in the following way:

- Using a 1.5 mm Allen key, undo the screw (fig. 22, index 6), and retract the gear 2 mm to the left.
- Tighten up the screw.

NOTE: Check that all galvanometers are illuminated normally, together with the event markers. If this is not the case, advance the discriminator by adjusting the gear (fig. 22, index 6).

2.8.3 - Adjusting the galvanometers

No measurement input should be connected to the adaptors.

If amplifiers are in service, the passing contact switch (fig. 21, index 11 must be held depressed in the "0" position during phases 2 and 3.

1 - Turn the elevation adjustment screws (fig. 20 index 1), so as to bring the spots into the recording window.

2 - Operating the elevation adjustment screws, bring the spots to the lower visible limit of the recording window, so as to obtain full spot isochronism.

3 - Touch up any adjustment as required.

NOTE: Galvanometers should be used, as far as possible, within the indicated deflection field (see fig. 3).

NOTE: The spot for the channel in question may be masked by one of the discriminator arms. In this case, move the discriminator by running the motor for a few moments, at a speed of 100 mm/s for example, or alternatively depress the loading pushbutton.

2.8.4 - Adjusting amplifiers OA 4571/0, OM 4509/1, OM 4509/2 and OM 4509/4

2.8.4.1 - Zero adjustment

The type OA 4571/0 amplifier has no external zero adjustment, zero being adjusted in the factory. The zero adjustment operation described below is only executed on type OM 4509/1, OM 4509/2 and OM 4509/4 amplifiers.

1 - Check that the source is connected, and that measurement parameter value is zero, so as to ensure correct input impedance. Otherwise short the two inputs to the shield.

2 - Move the sensitivity selector (fig. 11 and 12, index 2) to the "x 1" position.

3 - Move the switch (fig. 21, index 12) on the amplifier power supply block to the "GALVA ZERO" position.

4 - Index the spot corresponding to the channel in use, by masking the galvanometer lens with a piece of paper.

5 - Return the switch on the amplifier power supply to the operating position, and adjust the "ZERO" control on the upper face of the amplifier (fig. 11 and 12, index 3) so that the spot does not move when the sensitivity selector is turned to the "x 50" positio (OM 4509/2 and OM 4509/4, fig. 12, index 2), or the "x 10" positio (OM 4509/1, fig. 11, index 2).

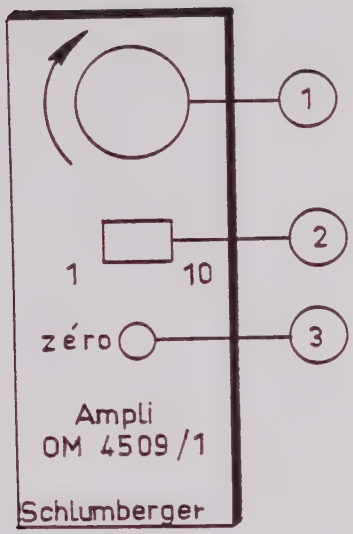


Fig 11

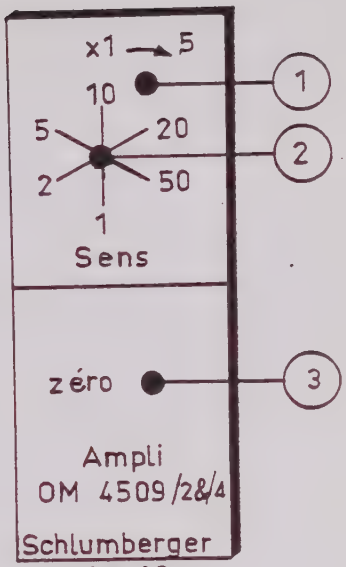
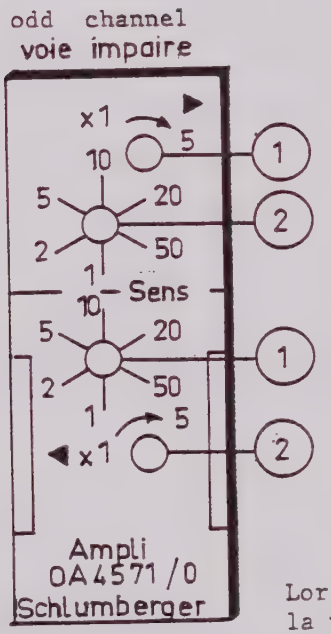


Fig 12



even channel
voie paire

Fig 13

OM 4509/1/2/4

br 1 entrée +	pin 1 input +
br 2 blindage	pin 2 shield
br 3 entrée -	pin 3 input -

OA 4571

br 1 + entrée	pin 1 input +	odd channel voie impaire
br 3 -	pin 3 input -	
br 4 + entrée	pin 4 input +	even channel voie paire
br 5 -	pin 5 input -	
br 2 blindage	pin 2 shield	

Lorsqu'un cordon 3 conducteurs est utilisé la voie active est la voie impaire.

When a 3 pin plug-in is used, the odd channel is only active.

Fig 11, 12 et 13

6 - Adjust sensitivity to maximum value on the amplifier gain control (fig. 11, index 1, or fig. 12, index 1), and complete adjustment.

2.8.4.2 - Calibration

Having first adjusted amplifier zero, insert the amplifier lead shield wire and "low" wire, in the black socket on the power supply unit. Insert the "high" wire in the socket corresponding to the selected reference voltage (fig. 21, index 10):

- Blue: 10 mV DC
- Yellow: 100 mV DC
- Red: 1 V DC.

Adjust elongation to absolute value, by means of the gain adjustments (see figs. 3 , 5 and 6).

2.8.5 - Auxiliary unit type OM 4509/3

This auxiliary unit can be used:

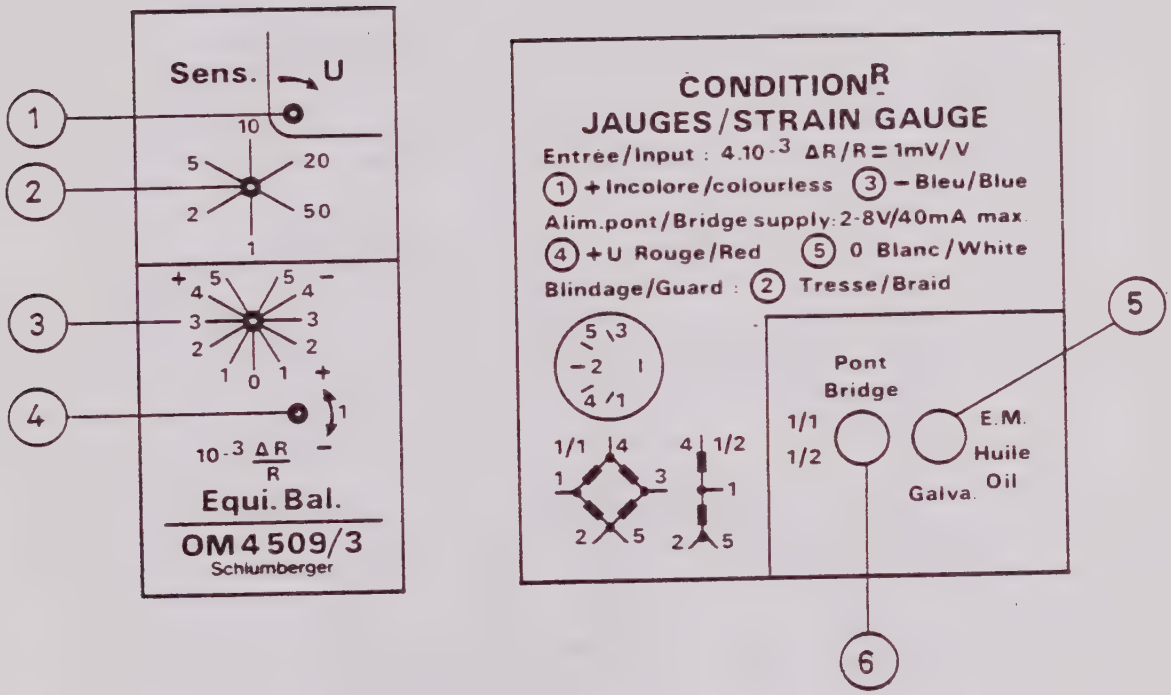
- As an extensometry auxiliary unit, with a strain-gauge bridge or half-bridge,
- As an amplifier (differential or not),
- As an auxiliary unit with a single strain-gauge.

2.8.5.1 - Utilization as an extensometry auxiliary unit

The voltage of a device using a strain-gauge bridge is equal to:

$$v = \frac{V}{4} \Sigma \frac{\Delta R}{R}$$

where V is the strain-gauge bridge power supply voltage (bridge or half-bridge),
and $\Sigma \frac{\Delta R}{R}$ is the sum of relative resistance variations resulting from the stresses generated by the parameter measured.



Connection of OM4509/3 with differential input arrangement

br 1 + input
br 2 shield
br 3 - input
br 4 do not connect
br 5 electrical ground

Branchement OM4509/3 avec montage entrées différentielles

br 1 entrée +
br 2 blindage
br 3 entrée −
br 4 à ne pas brancher
br 5 masse électrique

with unbalanced input arrangement

br 1 + input
br 2 shield
br 3 connect to electrical ground
br 4 do not connect
br 5 electrical ground

avec montage entrée asymétrique

br 1 entrée +
br 2 blindage
br 3 à relier à la masse électrique
br 4 à ne pas brancher
br 5 masse électrique

Fig 14

Maximum output for powering strain-gauges is 40 mA, and to avoid any risk of exceeding this output, the following values should be used:

- 100 Ω strain-gauges: 4 V
- 120 Ω strain-gauges: 4.8 V
- Resistive gauges of over 200 Ω: 8 V.

For gauges glued to a metal structure, use a voltage between 2 and 8 V.

For gauges glued to a plastic structure, use 2 V.

Having selected the galvanometer (see fig. 7), move the switch (fig. 14, index 6), to the following position:

"1/1" if a strain-gauge bridge is used (4 gauges),
"1/2" if a half-bridge is used (2 gauges).

- Insert the adaptor.
- Select strain-gauge power supply voltage.
  Adjust voltage to the selected value on control "U" (fig.14, index 1) with a voltmeter connected to pins 4 and 5 of the input socket.
  Do not exceed a maximum current of 40 mA (max. 4.8 V for 120 Ω strain-gauge bridge).
- Move the sensitivity selector to the "x 1"position.
- Move the strain-gauge bridge balance selector (fig. 14, index 3) to the "0" position.
- Connect the strain-gauge lead.

Ensure that the length of the connecting leads does not produce any voltage drop. A line resistance of 1 Ω (two-way) produces a sensitivity loss of 1% in the case of 120 Ω resistive gauges, calibration error being of a similar value.

Balancing of the strain-gauge bridge

1 - Depress the switch (fig. 21, index 11), and index the position of zero.

2 - Release the switch, and balance the bridge by means of the balance selector, so as to obtain minimum deviation.

3 - Complete balance adjustment on the balance control (fig. 14, index 4). Increase sensitivity progressively on the sensitivity selector, and complete balance adjustment.

Utilization

Select the appropriate sensitivity selector position, according to strain values, following the table shown in fig. 4 and details given in § 2.6.

Calibration

The balance selector is also used for calibration.

$$1 \text{ selector step} = 1.10^{-3} \frac{\Delta R}{R}$$

To obtain the desired elongation, power supply voltage to the strain-gauge bridge can be adjusted by careful manipulation of control "U".

2.8.5.2 - Utilization in the amplifier mode (differential or not)

Zero adjustment

Having determined the appropriate type of galvanometer:

- Move the switch (fig. 14, index 5) to "oil" or "EM".
- Move the switch (fig. 14, index 6) to "1/1".
- Make the input connections as indicated (fig. 14).
- Move control "U" to a mid-way position.
- Where applicable, short the two inputs to each other, if input value is non-zero.
- Depress the switch (fig. 21, index 11), and index the quiescent position of the spot.
- Release the switch, and adjust zero on the balance selector, completing the operation with the progressive adjustment.
- Increase amplifier sensitivity, and complete adjustment.

This zero adjustment system can be used to compensate slight offset at input (± 10 mV), in which case control "U" is again used. Select the appropriate position for the sensitivity selector, according to fig. 7.

2.8.5.3 - Utilization with a single strain-gauge

In this case, it is necessary to revert to a half-bridge configuration. For this purpose, use an additional resistance having a value equal to that of the strain-gauge (accuracy: 10^{-3}), and refer to § 2.8.5.1.

2.8.6 - Paper run time control unit OM 4521/0

To obtain a given chart paper run time between 1 second and 10 minutes, proceed as follows: select run time (fig. 15 indices 1 and 2). There are 3 ways of obtaining this run time:

1 - Move the motor switch to "on" and then to "off". (fig. 19 - 6)

2 - Depress the loading pushbutton once. (fig. 19 index 8)

3 - If the remote control unit is used, move the interrupter switch on the RC unit first to "on" and then to "off".

If the motor switch is left in the "on" position (to the right), or if the RC unit switch is left "on", the paper run time selector is inhibited, and paper run is not interrupted by this device.

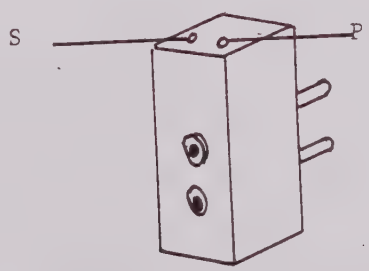
2.9 - Adjustment of adaptors

2.9.1 - Adaptor type OM 4510/1

This unit is used with galvanometers having a natural frequency of 100 or 200 Hz.

The two adjustments are inter-acting:

1 - Adjust the resistance placed between pins 3 and 4 (see figure below), to 120 Ω ± 5 Ω, by means of adjustment "P".



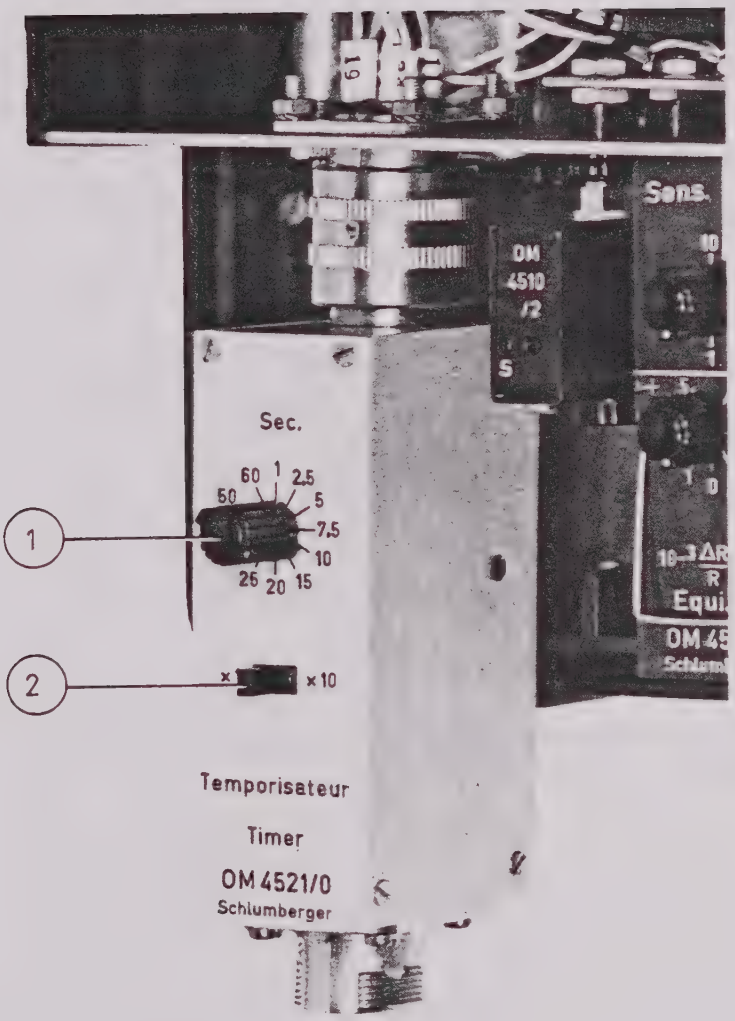

Sens.
OM
4510
/2
S
Sec.
60
1
2,5
50
5
7,5
10
25
20
15
1
2
x
x 10
Temporisateur
Timer
OM 4521/0
Schlumberger

Fig. 15

2 - Adjust sensitivity on control "S":

Average sensitivity	100 Hz	200 Hz
Minimum	200 mV/cm	560 mV/cm
Maximum	12.8 mV/cm	40 mV/cm

If internal resistance of the measurement source is less than 1500 Ω, damping control "P" should be readjusted to obtain correct frequency response.

2.9.2 - Adaptor type OM 4510/2

This adaptor is used with galvanometers having natural frequencies as follows:

- 1000 Hz OM 4517/2 - OM 4517/4
- 1800 Hz OM 4517/3 - OM 4517/5
- 2500 Hz OM 4517/6 - OM 4517/7

Adjust control "S" until the desired sensitivity is obtained:

	1000 Hz	1800 Hz	2500 Hz
Min. average sensitivity	8.7 V/cm	35 V/cm	56 V/cm
Max. average sensitivity	0.61 V/cm	2.4 V/cm	3.9 V/cm
Max. current	14 mA	14 mA	14 mA
Max. elongation	8.5 cm	2 cm	1.3 cm

2.9.3 - Attenuator type OM 4510/3

This attenuator is used with type OM 4509/0 and 2 amplifiers. According to selector position, input signal division factor is 1/50 or 1/500.

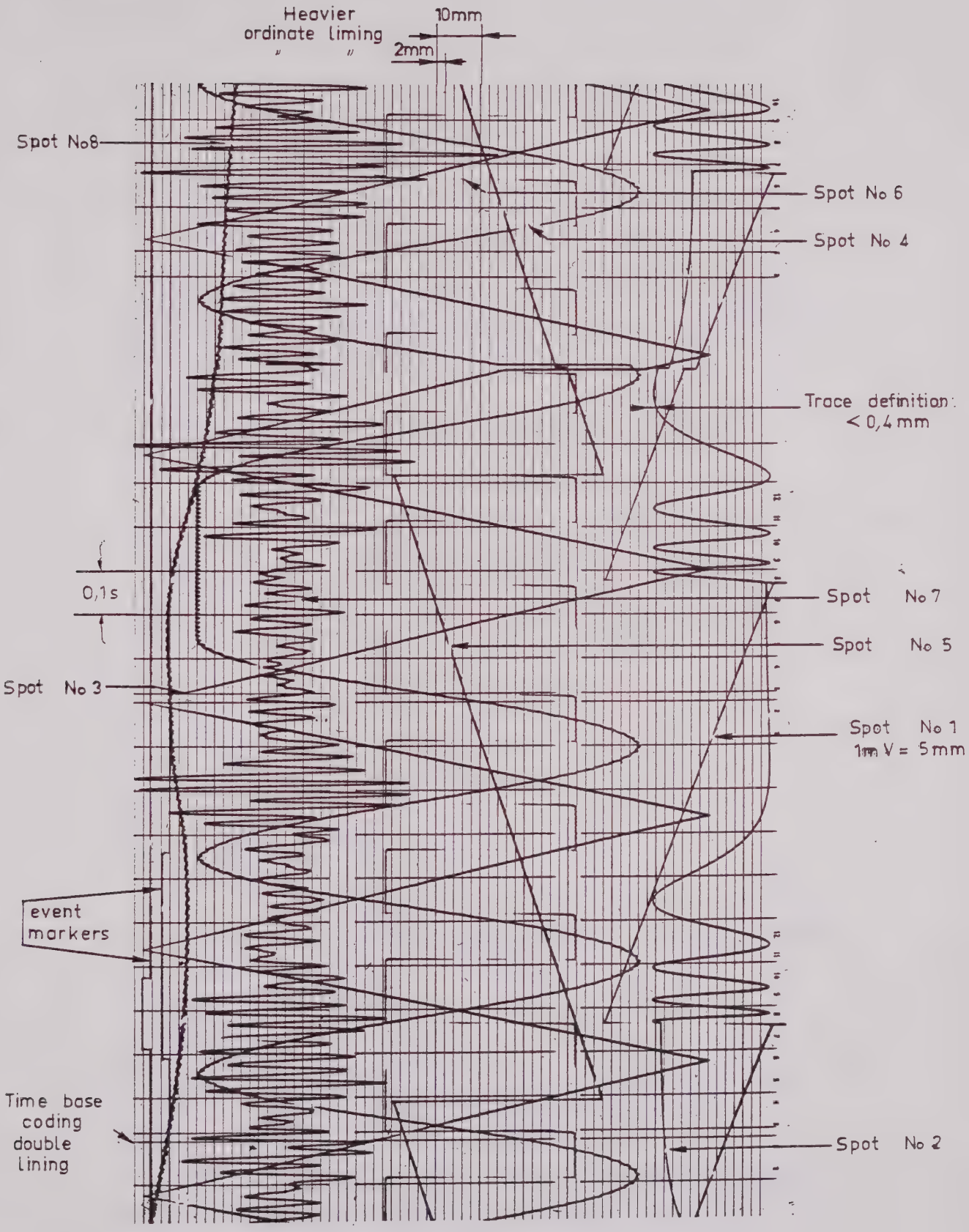

Heavier ordinate liming
10mm
2mm
Spot No8
Spot No 6
Spot No 4
Trace definition: < 0,4 mm
0,1s
Spot No 7
Spot No 5
Spot No 3
Spot No 1
1mV = 5mm
event markers
Time base coding double lining
Spot No 2

Fig. 16

Position	Input resistance	Max. input voltage
1/50	100 kΩ	500 V DC
1/500	1 MΩ	150 V DC

2.9.4 - Adaptor type OM 4510/0

This adaptor is supplied in its basic form. It comprises a housing containing the printed circuit, and carrying input and output terminals.

2.10 - Choice of chart paper and storage of recordings

Two types of paper are recommended:

- Type OA 4502/1 standard paper (emulsion colouring light green)
- Type OA 4550/1 high-speed paper (emulsion colouring pink).

The choice of paper is dictated by the following criteria:

a) Paper speed
b) Post-illumination
c) Storage of the recordings
d) Storage of non-exposed paper.

a) Paper speed

For paper speeds of less than 10 mm/second, namely 2.5, 1, and 0.25 mm/second, only standard paper must be used.

b) Post-illumination

Under normal lighting conditions (100 to 150 lux), the trace appears after 3 to 5 seconds with high speed paper, and after 10 to 15 seconds when standard paper is used.

If a stable image is desired, which is to be subjected to lengthy exposure to light, either untreated high speed paper or specially treated standard paper can be used (see below).

c) Storage of recordings

Standard paper

Post-illumination of the paper is in ambient light. Best results are obtained with natural or diffused artificial light (optimum results are obtained at about 150 lux).

Under these conditions, the trace may be preserved for a period of 48 hours. The recording can be stored away from ambient light (in drawers, files, etc.).

Permanent storage of important recordings, under daylight conditions, is possible if the recordings are treated with Kodak type MX 517.1 developer, followed by conventional fixing with hypo (Schlumberger ref. 935 500 01).

Chemical processing can be executed just as well in darkness as in a properly lighted room, without affecting the quality of the recording.

Processing applied to an emulsion which has not undergone post-illumination gives much better contrast. Paper which has undergone photolysis can also be stored in ambient light, if placed inside an orange-yellow transparent cover.

High speed paper

No chemical processing is required, and recordings can be stored in an ambient light of 100 lux.

In this case also, post-illumination can be carried out with no UV component (incandescent light), almost as fast as when a UV source is used (fluorescent tubes).

Results may be reproduced by xerographic process, provided that post-illumination has been carried out (elimination of the pink tint on the paper).

d) Storage or paper for use

Standard paper

Standard paper can be stored for 1 year at an ambient temperature of + 20/25°C (with 50% max. RH).

High speed paper

Under climatic conditions similar to those described above, the storage period for high speed paper does not exceed 3 months.

For storage up to 1 year, the paper must be held at a temperature of less than +4°C, with maximum relative humidity 50%.

Under these conditions, a stabilization period of 2 hours at ambient temperature is required before the paper can be used, for optimum results.

For both types of paper, limit conditions for utilization are as follows:

- above +45°C: clouding and loss of sensitivity
- over 70% relative humidity: emulsion migration.

2.11 - Utilization with slide cradle OM 4524/0 (fig. 17)

This adaptor is used for rack-mounting of the recorder. The latter is fixed, without modification, to a plate integral with a set of ball-mounted slides. The front portion of the recorder overlaps the plate, thus allowing easy access to the control panel and paper.

This arrangement also ensures normal display of the spots. The recorder is attached to the rack by means of 4 captive knurled screws, allowing access to the rear of the unit.

2.12 - Utilization with airborne mounting OM 4512/0 (fig. 18)

This accessory is used for installation of the recorder on board an aircraft or vehicle. It comprises a pre-formed sheet steel cradle, resting on 4 metal shock-mounts.

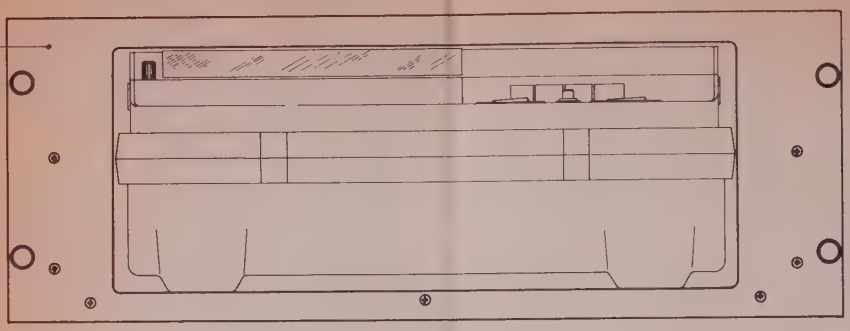
The recorder is inserted in the cradle, without modification, attachment being by means of 4 cleats on the mounting frame.

The shock-mount attachment plane is on a level with the centre of gravity of the recorder. Four tubular fittings supplied with each cradle, can be used to lower the attachment plane below the bottom of the cradle.

91231242

2 mb PHILLIPS M3V3

* Philips screws



8 captive nuts — 8 ecrous captifs M5

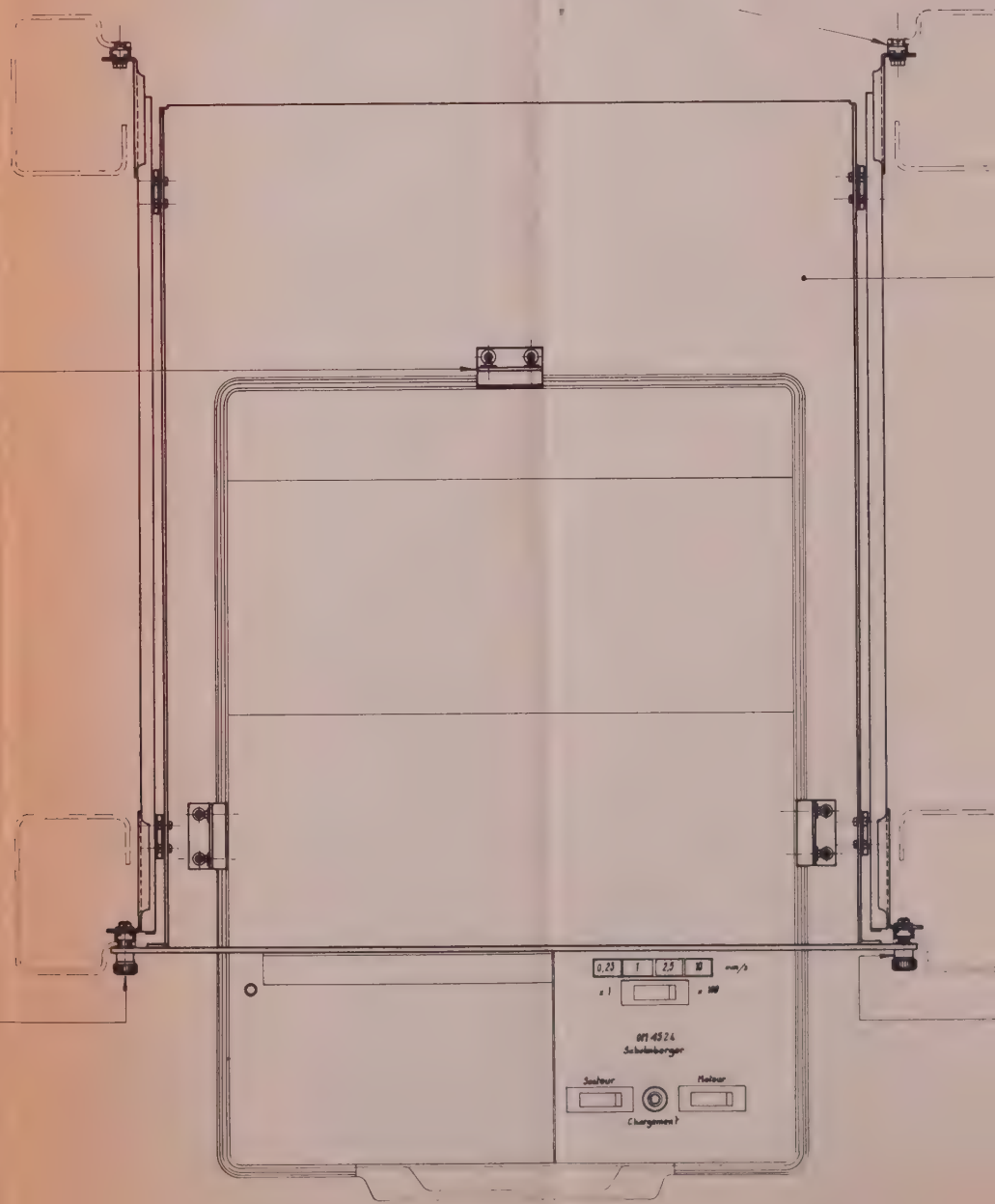
8 screws ref. S/5901 — 8 vis speciales ref S/5901 M5-18 EGÉE

8 washers — 8 rondelles MV-5

8 " — 8 " DE 5

8 nuts — 8 ecrous H M5

Detail A



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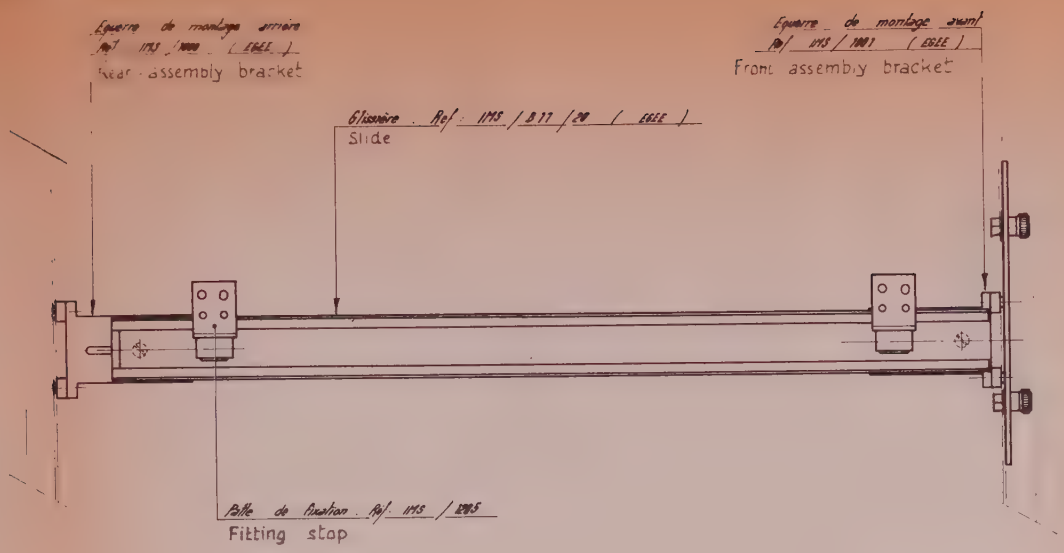
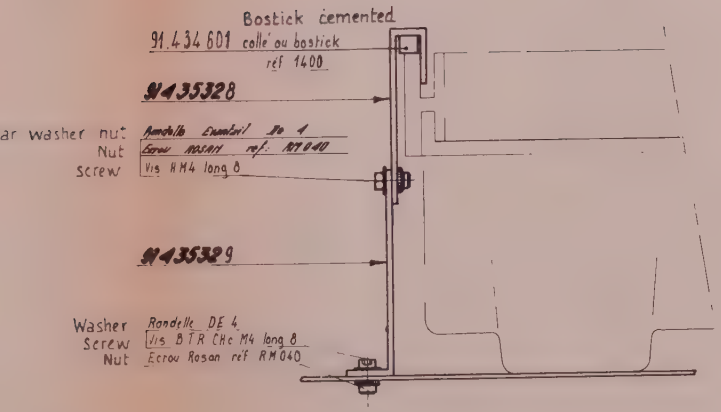

Equerre de montage arrière
Ref IMS / 1000 (EGEE)
Rear assembly bracket
Equerre de montage avant
Ref IMS / 1001 (EGEE)
Front assembly bracket
Glissière Ref: IMS / B77 / 20 (EGEE)
Slide
Butée de fixation Ref: IMS / 2005
Fitting stop

91 231240

ews 8 vis CH IMS long 10
ts 8 Ecrous H IMS



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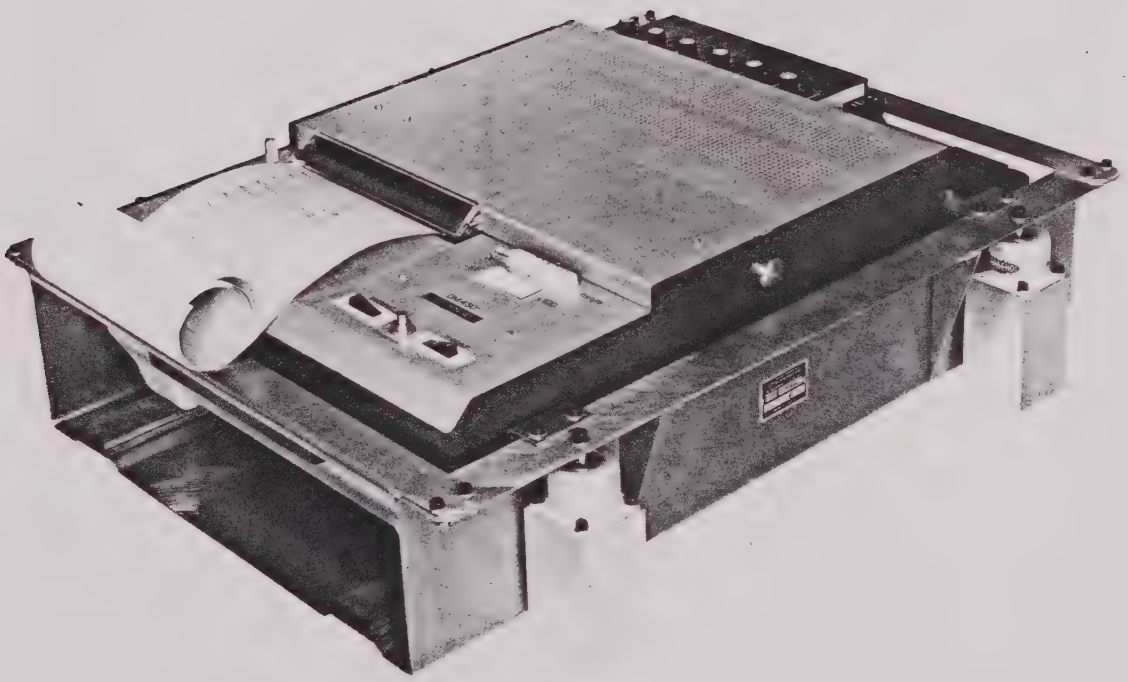
Détail A (Ech: 1)

Fig 17



Fixation des chandelles:
entr'axes 415 x 370 mm *center to center*
trous ϕ : 8,5 mm ,hauteur 10 mm *Holes ∅ 8.5 mm, heigt 10 mm*

Fig. 18

DESCRIPTION

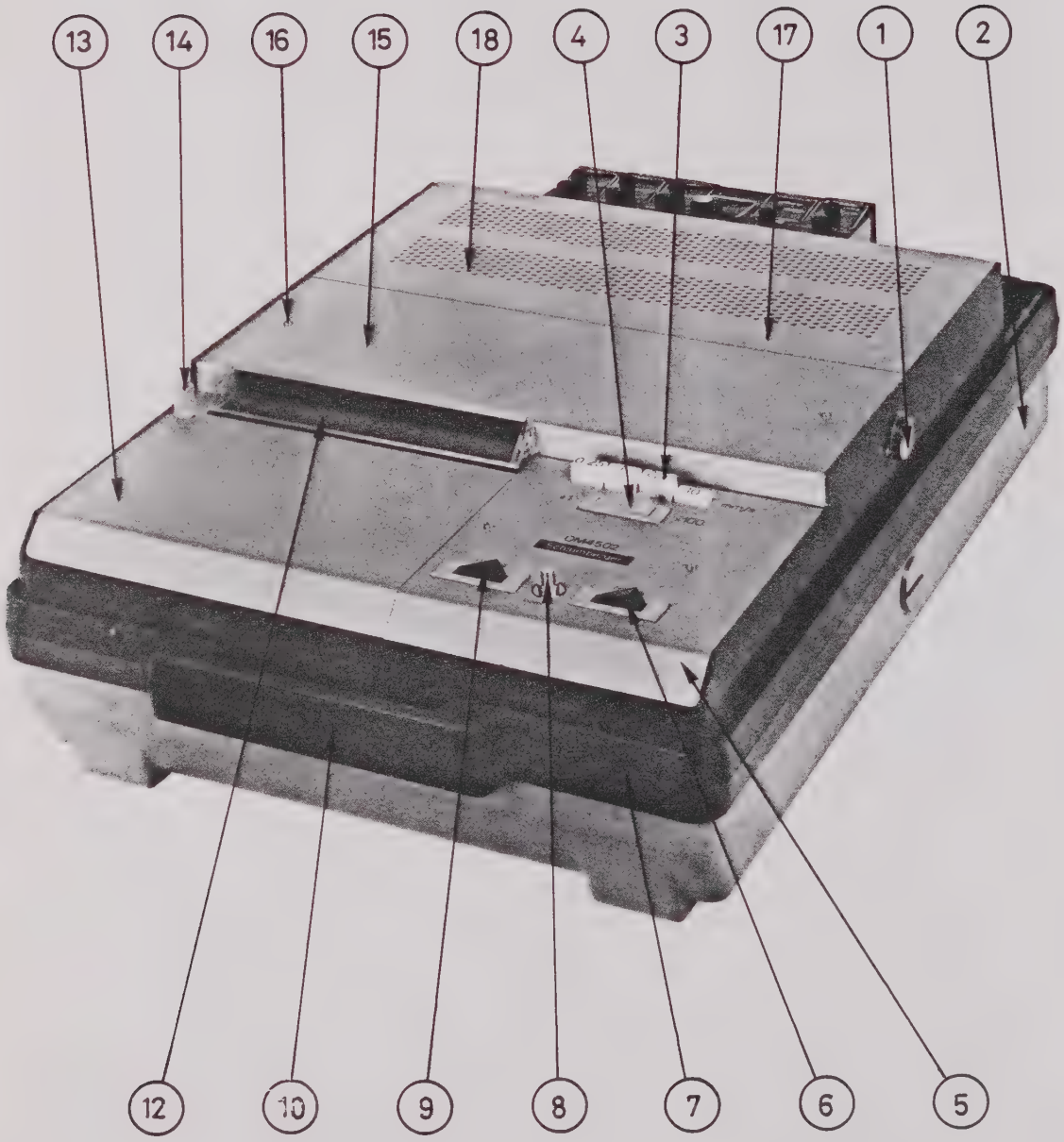


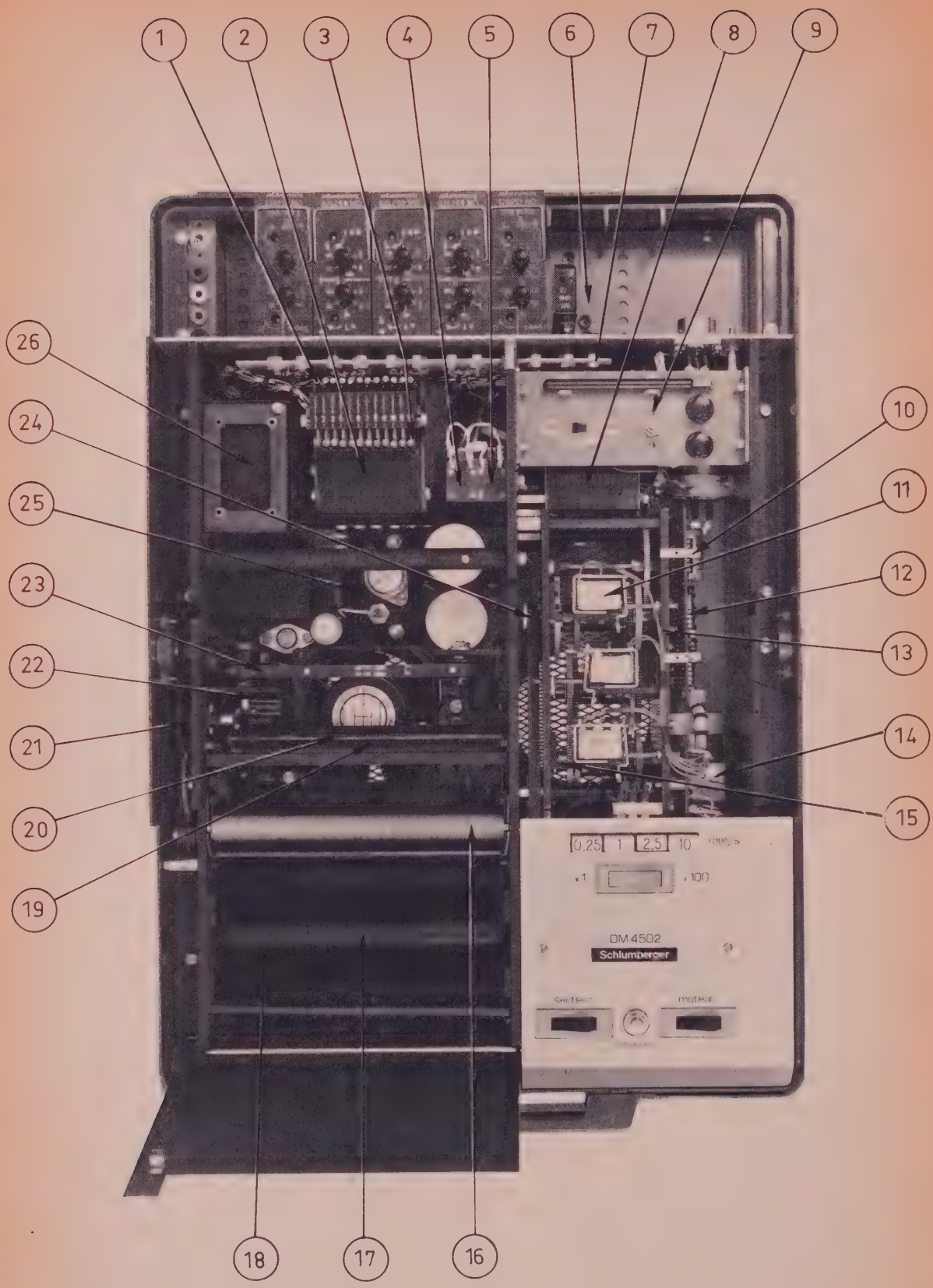
Fig. 19

3 - DESCRIPTION

3.1 - Fig. 19 - General view

1 - Pushbutton for recorder cover removal
2 - Mounting band
3 - Selector switch for 4 basic paper speeds
4 - Paper speed ratio selector (x 1/x 100)
5 - Control panel
6 - Motor "on/off" switch
7 - Recorder lower cover*
8 - Loading pushbutton
9 - Power "on/off" switch
10 - Retractable carrying handle
11 - Chart paper
12 - Display shade
13 - Paper magazine access trap
14 - Pushbutton for opening access trap (13)
15 - Recorder cover plate
16 - Cover plate attachment screw
17 - Access trap for light source and galvanometers
18 - Ventilation holes

* The recorder is normally presented in its carrying case. The lower cover is identified by the presence of 2 attachment screws, and the top cover by the presence of 2 ejector push-buttons, these having no screwdriver slots.


1
2
3
4
5
6
7
8
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10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
0.25
1
2.5
10
x1
x100
DM 4502
Schlumberger

Fig 20

3.2 - Fig. 20 - Internal view from above

1 - Elevation adjustment screw of galvanometer for channel 1
2 - Magnetic block
3 - Galvanometer for channel No. 12
4 - Electro-magnetic event marker No. 2 (SP2)
5 - Electro-magnetic event marker No. 1 (SP1)
6 - Amplifier nest
7 - Plate for interconnection between galvanometers and input terminals
8 - Power supply transformer
9 - Plate carrying: galvanometer extraction tool, line voltage selector, fuses, and interrupter switch for magnetic block heater system.
10 - Time base card lock
11 - Electro-magnet C
12 - Time base card
13 - Gearbox end-plate, used for mounting the time base card
14 - "Switching logic" card
15 - Gearbox clutch spring
16 - Capstan
17 - Shaft for paper roll
18 - Paper extractor blade
19 - Spot display mirror
20 - Mounting for parameter recording beam intermediate mirror
21 - Capstan gear (spot number discriminator drive)
22 - Spot numbering device
23 - Spot discriminator drive belt
24 - Gearbox drive belts
25 - Light card
26 - UV light source housing.

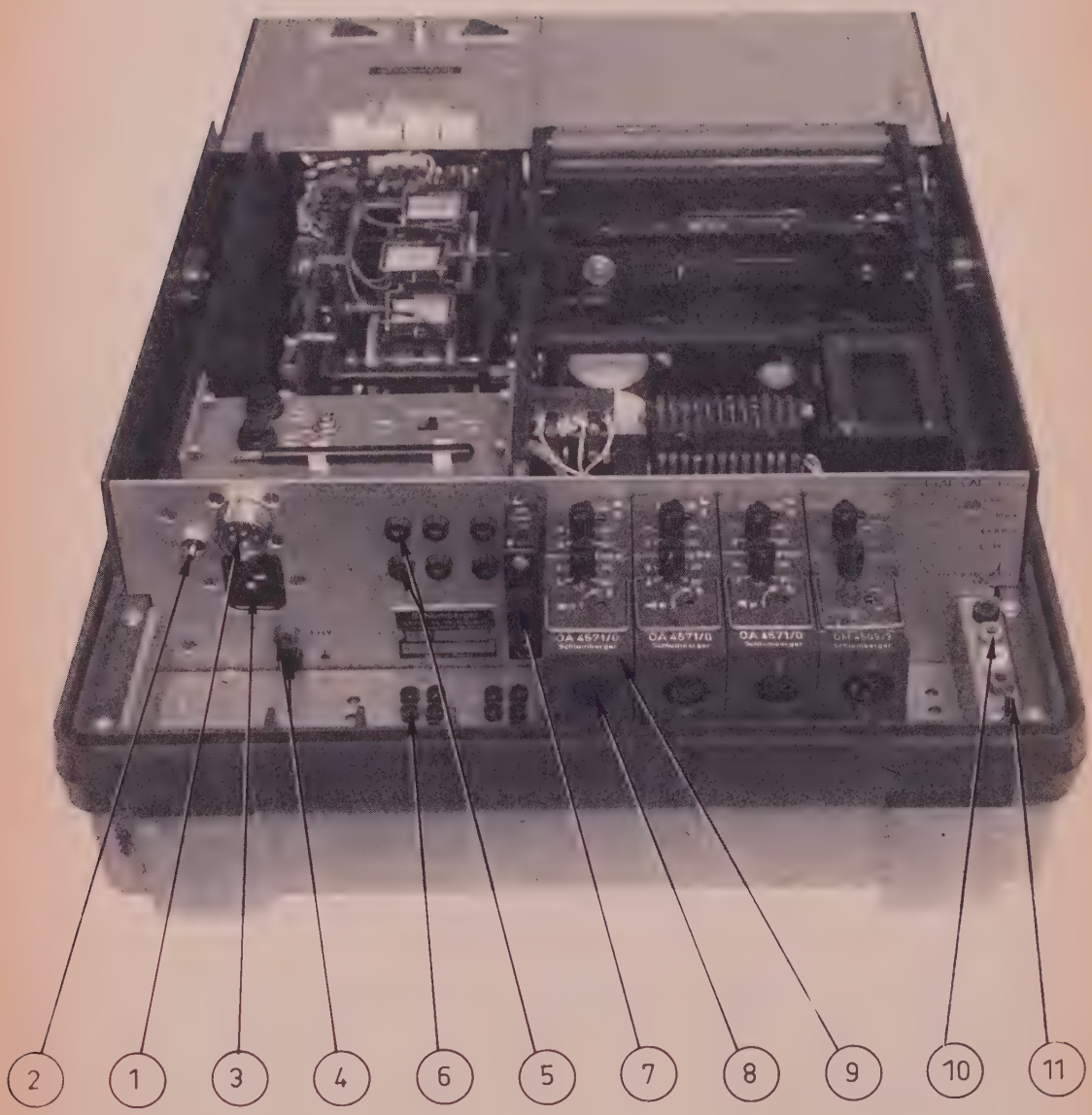


Fig 21

3.3 - Fig. 21 - Rear panel - Auxiliaires

1 - Remote control connector
2 - Event marker local control pushbutton (SP1)
3 - Line power supply connector
4 - 24 V output sockets
5 - OM 4510 adaptor
6 - Direct input sockets
7 - Amplifier plug-in sockets
8 - Amplifier input connector
9 - OM 4509 amplifier
10 - Reference voltage output sockets
11 - "GALVA ZERO" switch.

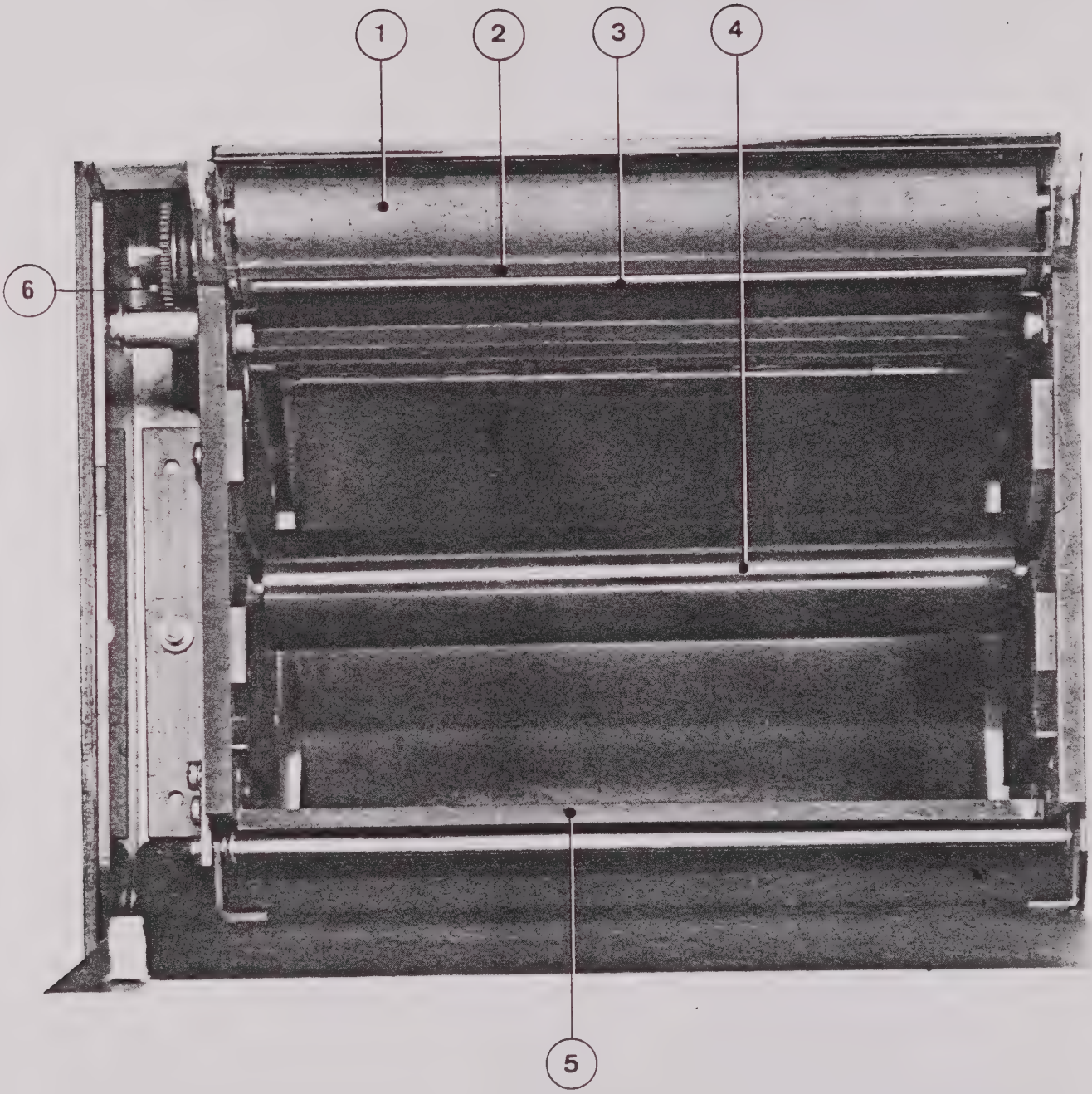


Fig 22

3.4 - Fig. 22 - Paper magazine

1 - Pinch-roller
2 - Capstan
3 - Anti-jamming guide
4 - Shaft position
5 - Extractor blade
6 - Discriminator drive gear lock screw

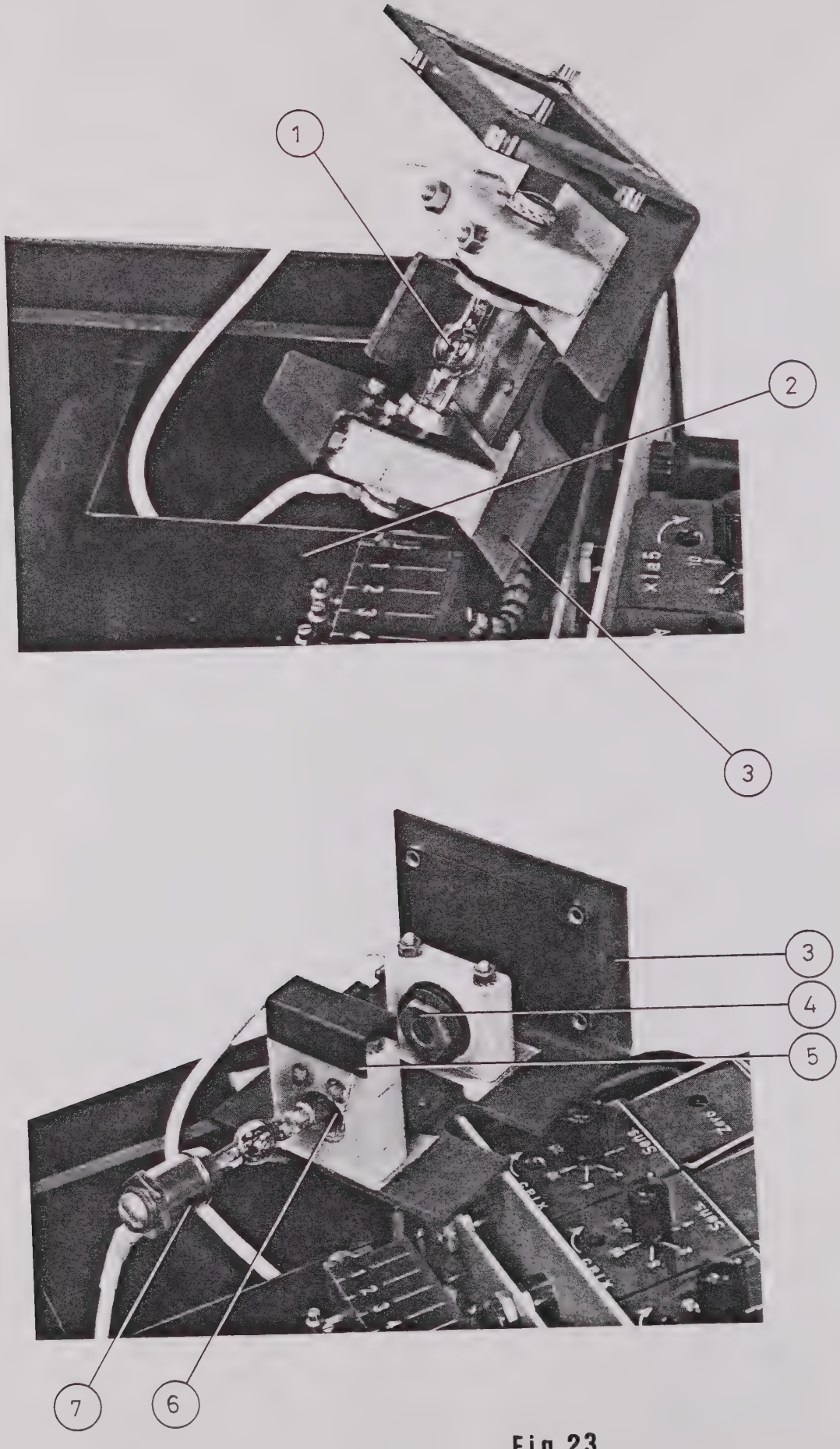


Fig 23

3.5 - Fig. 23 - Fitting the UV lamp

1 - High pressure UV lamp, type 50 W3
2 - UV lamp housing
3 - UV lamp bracket
4 - UV lamp upper socket
5 - UV lamp ejector pushbutton
6 - UV lamp insertion orifice
7 - UV lamp lower socket.

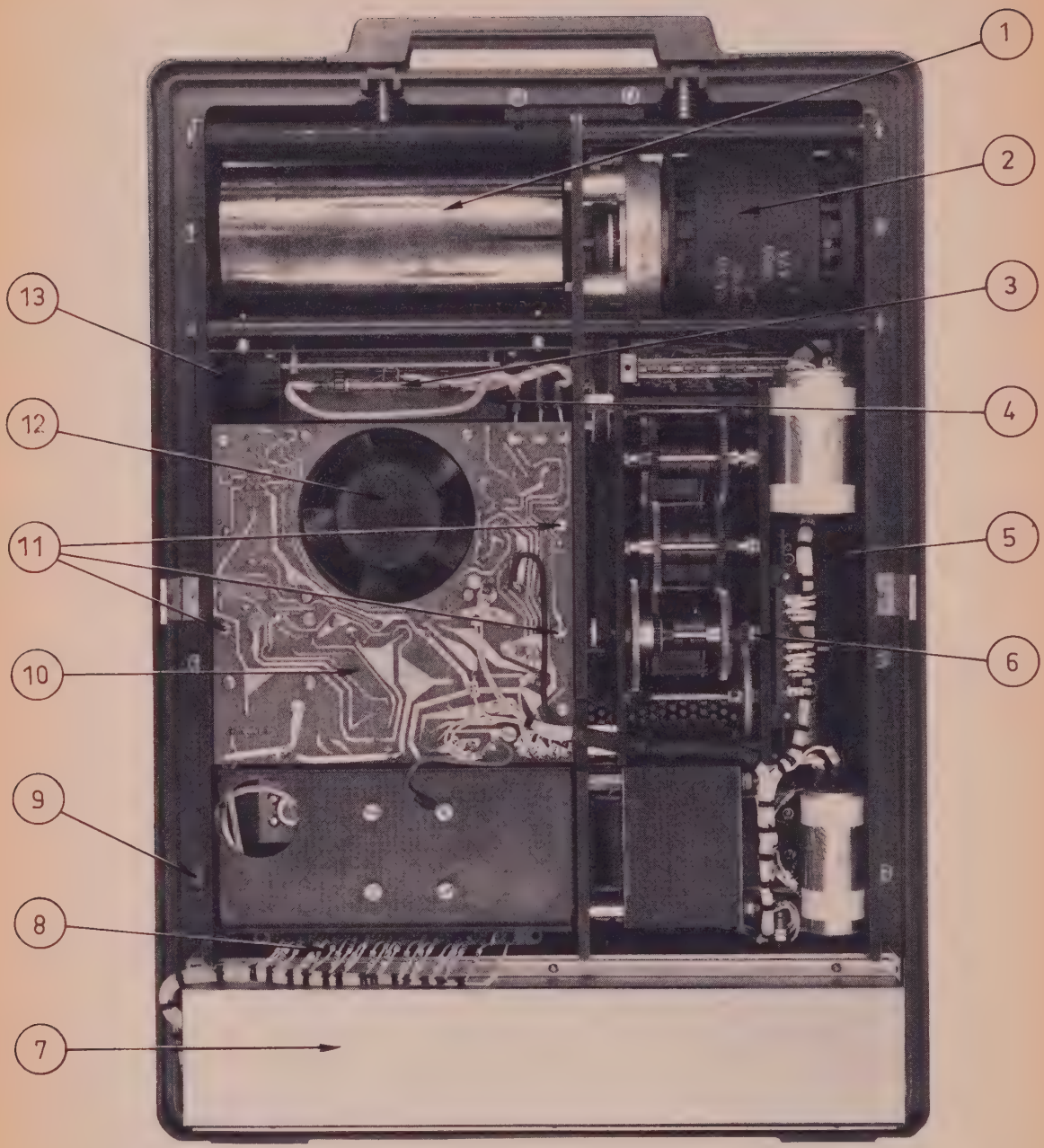


Fig 24

3.6 - Fig. 24 - View from below

1 - Extractor blade
2 - Drive motor
3 - Flashlamp
4 - Flashlamp protective cover
5 - Recorder right end-plate
6 - Gearbox right end-plate
7 - OA 4572/0 power supply (option)
8 - Amplifier power supply connector
9 - Mounting band attachment screw
10 - Light card
11 - Light card attachment screw
12 - Fan
13 - Time base focus lens

OPERATION

4 - OPERATION

4.1 - Paper drive system

The drive system comprises the following elements:

- Motor
- Gearbox
- Drive rollers.

4.1.1 - Drive motor (fig. 24, index 2)

This is a single-phase synchronized asynchronous motor, with starter capacitor, having a power rating of 15 W. It is connected to an electro-magnetic gearbox, and has a rotational speed of 1500 rpm.

4.1.2 - Gearbox

This provides 8 different paper speeds, obtained from 8 ratios ranging from 2/3 for maximum speed to 1/6000 for minimum speed.

The gearbox comprises a series of gears and spring-clutches. The latter are controlled by 3 electro-magnets. The 8 gear ratios are obtained by using one electro-magnet, or combinations of 2 or 3.

The 3 electro-magnets are powered from the "switching logic" card, and are controlled from a pushbutton keyboard and inverter switch on the control panel.

The electro-magnets used for the various paper speeds are shown in the table on page 4.2.

KEYBOARD				INVERTER		SPEED (mm/s)	ELECTRO-MAGNETS		
0.25	1	2.5	10	1	100		A	B	C
X	-	-	-	X	-	0.25	-	-	-
-	X	-	-	X	-	1	X	-	-
-	-	X	-	X	-	2.5	-	X	-
-	-	-	X	X	-	10	X	X	-
X	-	-	-	-	X	25	-	-	X
-	X	-	-	-	X	100	X	-	X
-	-	X	-	-	X	250	-	X	X
-	-	-	X	-	X	1000	X	X	X
LOADING						100	X	-	X

4.1.3 - Drive rollers (figs. 22 and 25)

Three rollers are used in the paper drive system:

- Capstan: connected to the drive system by a toothed belt.
- Pinch-roller: applies the paper to the capstan.
- Drive roller: connected to the capstan by a belt, on the left side of the unit, this roller ensures correct tensioning of the paper, and facilitates positioning of the paper during loading.

The belt, providing capstan/drive roller coupling, makes it possible to obtain rotational speeds which are slightly different. This ensures correction tensioning of the paper (capstan and drive roller diameters are identical).

4.1.4 - Paper run (fig. 25)

The paper from the roll is directed under the drive roller, and is then driven by the capstan. It passes under the pinch-roller, and continues towards the outlet slot.

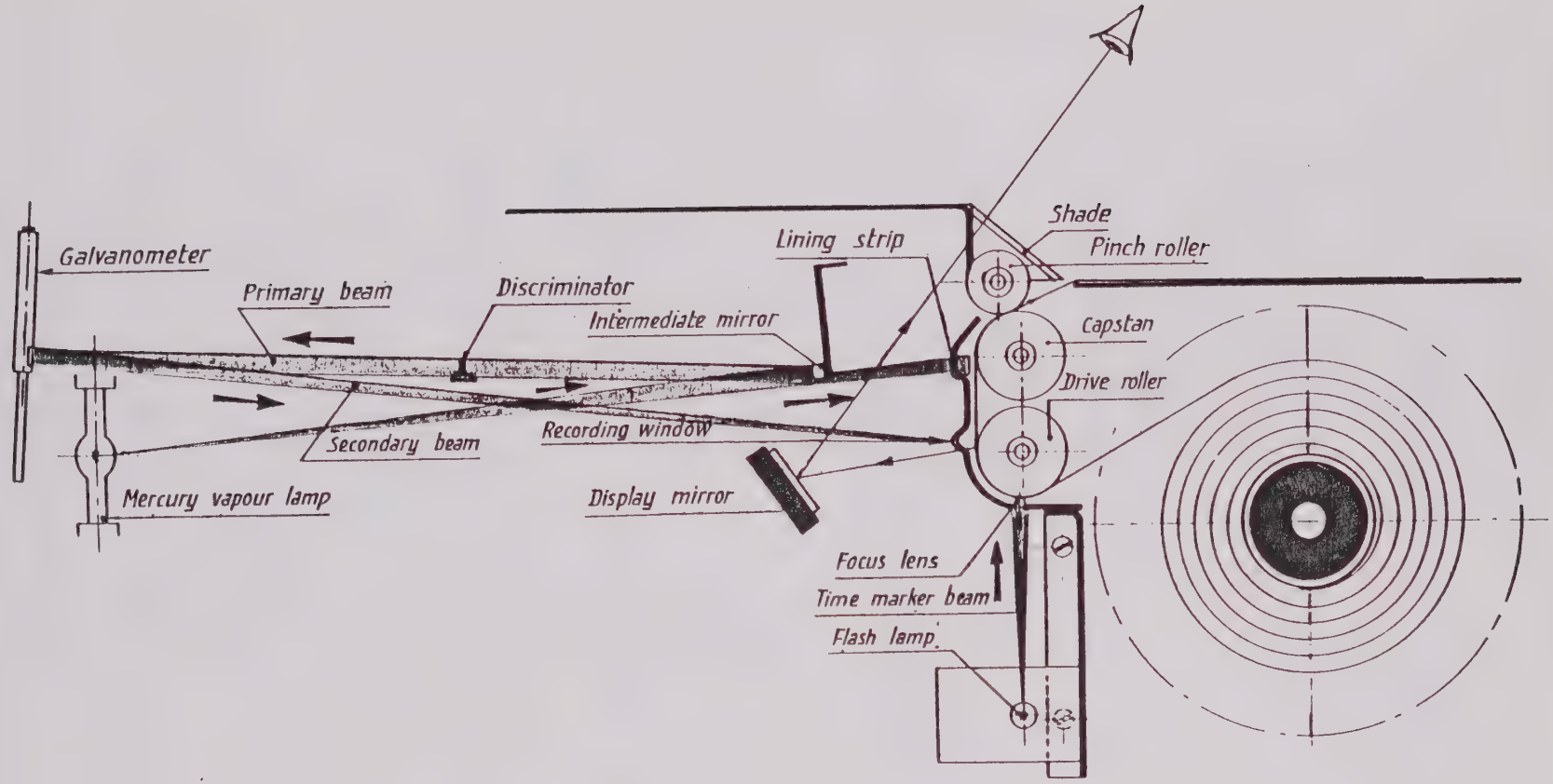

Galvanometer
Primary beam
Discriminator
Intermediate mirror
Lining strip
Shade
Pinch roller
Capstan
Drive roller
Secondary beam
Recording window
Mercury vapour lamp
Display mirror
Focus lens
Time marker beam
Flash lamp

Fig.25

4.2 - Optics

4.2.1 - Optical system (fig. 25)

Traces are recorded on the chart paper by means of the recorder optical system. This system is described in § 1.1.2.

There are 5 separate circuits:

- Parameter recording circuit,
- Lining circuit,
- Time recording circuit,
- Event marker recording circuit,
- Spot numbering circuit.

4.2.1.1 - Parameter recording circuit

The light beam from the mercury vapour lamp strikes the mirror/lens assembly of the galvanometer, and is then reflected and focused onto the recording paper.

4.2.1.2 - Lining circuit

Lining is recorded by means of a marginal beam from the mercury vapour lamp. This beam strikes an engraved strip mounted on a bracket, and records on the paper at the point defined by the engraving.

Lining is recorded after the parameters. Lines are printed every 2 mm, with a heavier line every 10 mm.

4.2.1.3 - Time recording circuit

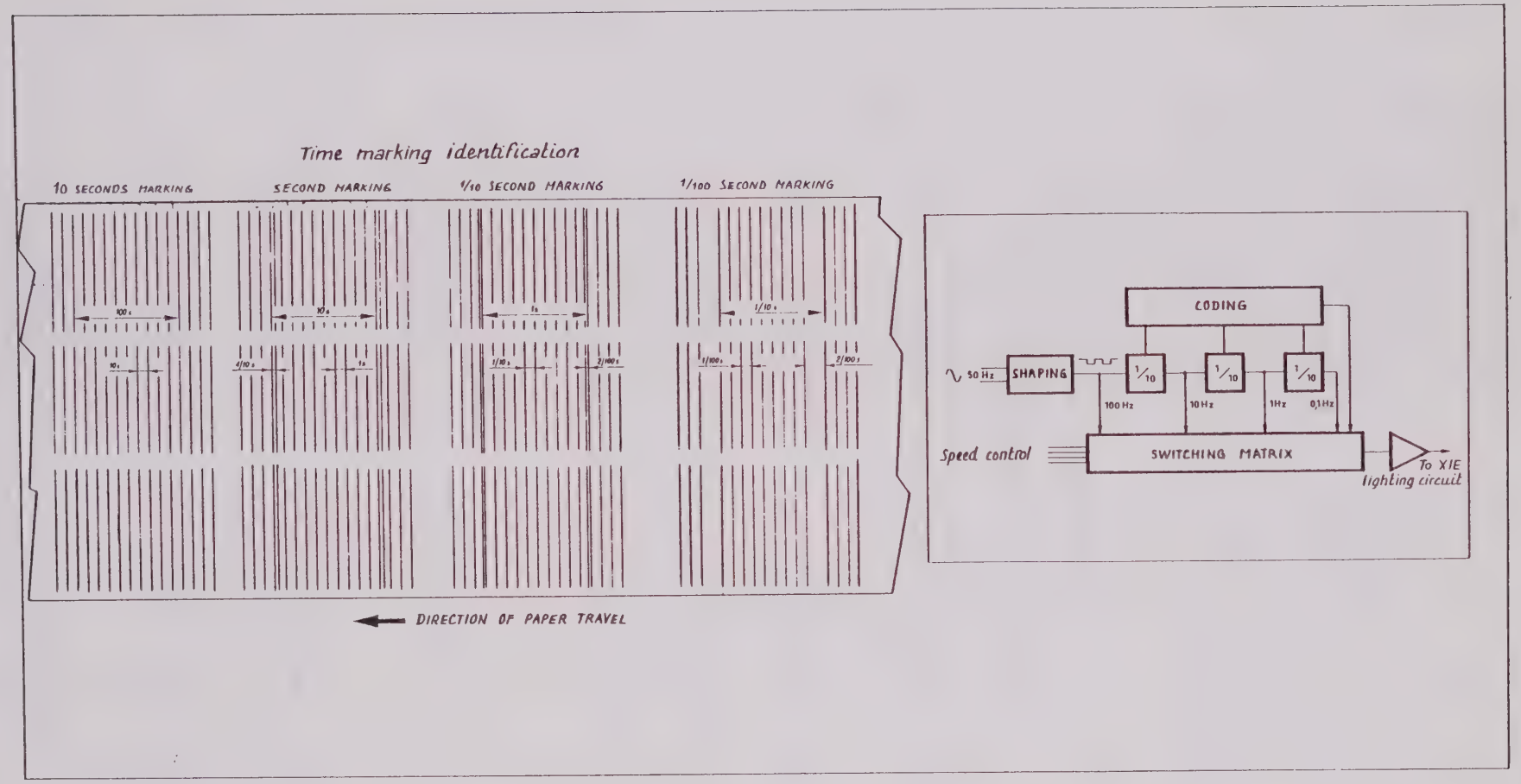
Flashes from the flashlamp are focused by a cylindrical lens, then striking the paper. The traces are recorded at right angles to the direction of paper travel.

Time recording occurs before parameter recording.

4.2.1.4 - Event marker recording circuit

The beam from the mercury vapour lamp is reflected, first by the intermediate mirror, and then by the mirrors for the two event markers.

Fig.26


Time marking identification
10 SECONDS MARKING
SECOND MARKING
1/10 SECOND MARKING
1/100 SECOND MARKING
DIRECTION OF PAPER TRAVEL
CODING
50 Hz
SHAPING
1/10
1/10
1/10
100 Hz
10 Hz
1Hz
0,1Hz
Speed control
SWITCHING MATRIX
To XIE
lighting circuit

The beam records in the margin of the recording paper.

These signals are recorded simultaneously with the parameters.

4.2.1.5 - Spot numbering recording circuit

Spot numbers are recorded at the same time as lining.

The rotational speed of the numbering drum is selected so that the image of the number to be recorded, is moving at the same speed as the chart paper.

4.2.2 - Power supply for light sources

4.2.2.1 - Mercury vapour lamp power supply (fig. 27)

This power supply operates on the switching principle, thus ensuring high efficiency. It is servo-controlled at constant power.

Stabilization of the mercury vapour lamp is obtained in 3 successive phases:

a) During switch-on, bias pulses of 4 to 6 kV, obtained from a transformer and relaxation circuit, are applied to the lamp.

   This circuit is inhibited as soon as the arc appears, on striking.

b) Striking:
   During this phase, lamp temperature is raised progressively to the stabilization point.

c) Maintenance of the arc:
   The power supply delivers a regulated voltage to the lamp, from an electronic chopper circuit (from 20 V, 2.5 A to 34 V, 1.5 A).

   The chopper circuit is controlled by a linear combination of lamp voltage and current, so as to ensure operation at constant power.

4.2.2.2 - Flashlamp power supply - time base (50 Hz) OM 4515/1

The flashlamp, used for time recording, is driven by a coded time base (fig. 28).

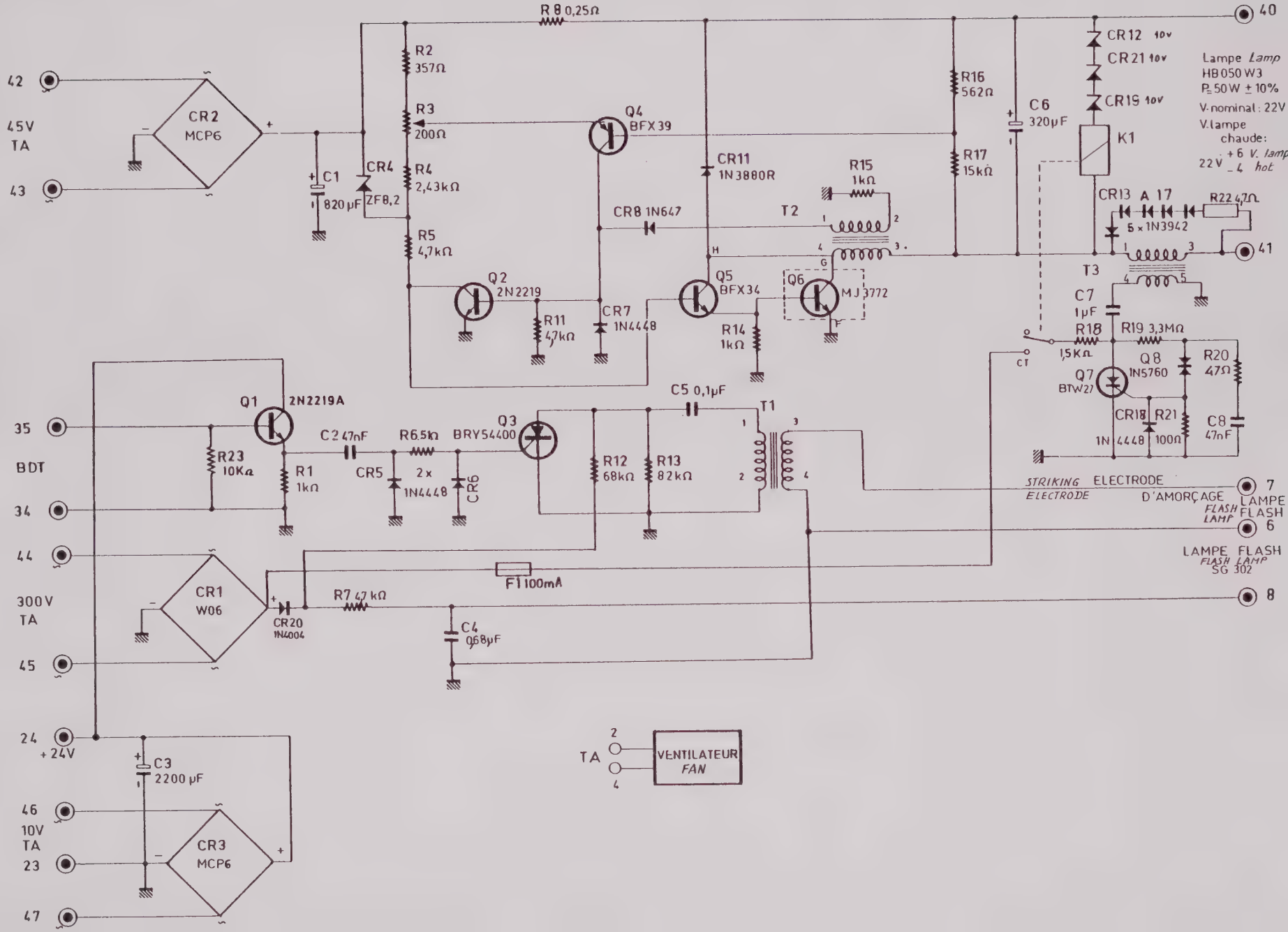

R8 0,25Ω
40
42
45V TA
43
CR2 MCP6
C1 820µF
CR4 ZF8,2
R2 357Ω
R3 200Ω
R4 2,43kΩ
R5 4,7kΩ
Q4 BFX39
CR11 1N3880R
R15 1kΩ
R16 562Ω
R17 15kΩ
C6 320µF
CR12 10v
CR21 10v
CR19 10v
K1
Lampe Lamp HB050W3 P≥50W ±10% V.nominal: 22V V.lampe chaude: 22V +6 V. lamp -4 hot
CR13 A 17
5 x 1N3942
R22 47Ω
41
T2
CR8 1N647
Q2 2N2219
R11 4,7kΩ
CR7 1N4448
Q5 BFX34
R14 1kΩ
Q6 MJ3772
T3
C7 1µF
R18 1,5kΩ
R19 3,3MΩ
CT
Q8 1N5760
Q7 BTW27
R20 47Ω
CR18 1N4448
R21 100Ω
C8 47nF
C5 0,1µF
T1
Q1 2N2219A
Q3 BRY54400
35
BDT
34
R23 10Kα
R1 1kΩ
C2 47nF
CR5
R6 5kΩ
2x 1N4448
CR6
R12 68kΩ
R13 82kΩ
STRIKING ELECTRODE
ELECTRODE D'AMORÇAGE LAMPE FLASH LAMP
7
6
LAMPE FLASH FLASH LAMP SG 302
44
300V TA
45
CR1 W06
F1 100mA
CR20 1N4004
R7 47kΩ
C4 0,68µF
8
24
+24V
C3 2200µF
46
10V TA
23
47
CR3 MCP6
TA
2
4
VENTILATEUR FAN

Fig 27

The driver element is supplied from 50 Hz line source, ensuring an accuracy of 10^{-3}. Line voltage is converted into a square-wave signal, with a frequency of 100 Hz.

The pulses thus obtained are sent to 3 x 10 dividers, comprising integrated circuits wired in series. These dividers provide pulses with frequencies of 10 Hz, 1 Hz, and 0.1 Hz, these then being coded by a logic circuit. This allows immediate identification of times on the chart paper (fig. 26).

The signals are amplified, and then applied to the gate of a thyristor. This allows discharge of a capacitor to the primary of pulse transformer T1 (fig. 2).

The secondary pulses (5 to 7.5 kV) produce flashes with an average duration of 10 to 50 µs, obtained by discharge of capacitor C4 to the flashlamp (fig. 27).

Speed (mm)	0.25	1	2.5	10	25	100	250	1000
Time (s)	-	10	10	1	1	0.1	0.1	0.01

4.2.2.3 - Crystal-driven time base OM 4522/0 (option) (fig. 29)

This card is inserted in place of the OM 4515/0 standard time base card, and comprises:

- power supply (+5 V and -12 V) for circuit IC 1
- circuit IC 1, associated with crystal Q1, generating a frequency of 1 MHz.

Following division by IC1, we obtain a signal with a frequency of 1 Hz at output, used for the coded time base.

4.2.3 - Spot display

The spots are displayed through a shade, used to prevent UV radiation, via an intermediate mirror.

This display makes it possible to position the spots with respect to the index lines, viewed via the display window, and to observe spot deflection.

10Veff.
vers TRA
to PS
transf
+5V
CR17
R18
390Ω

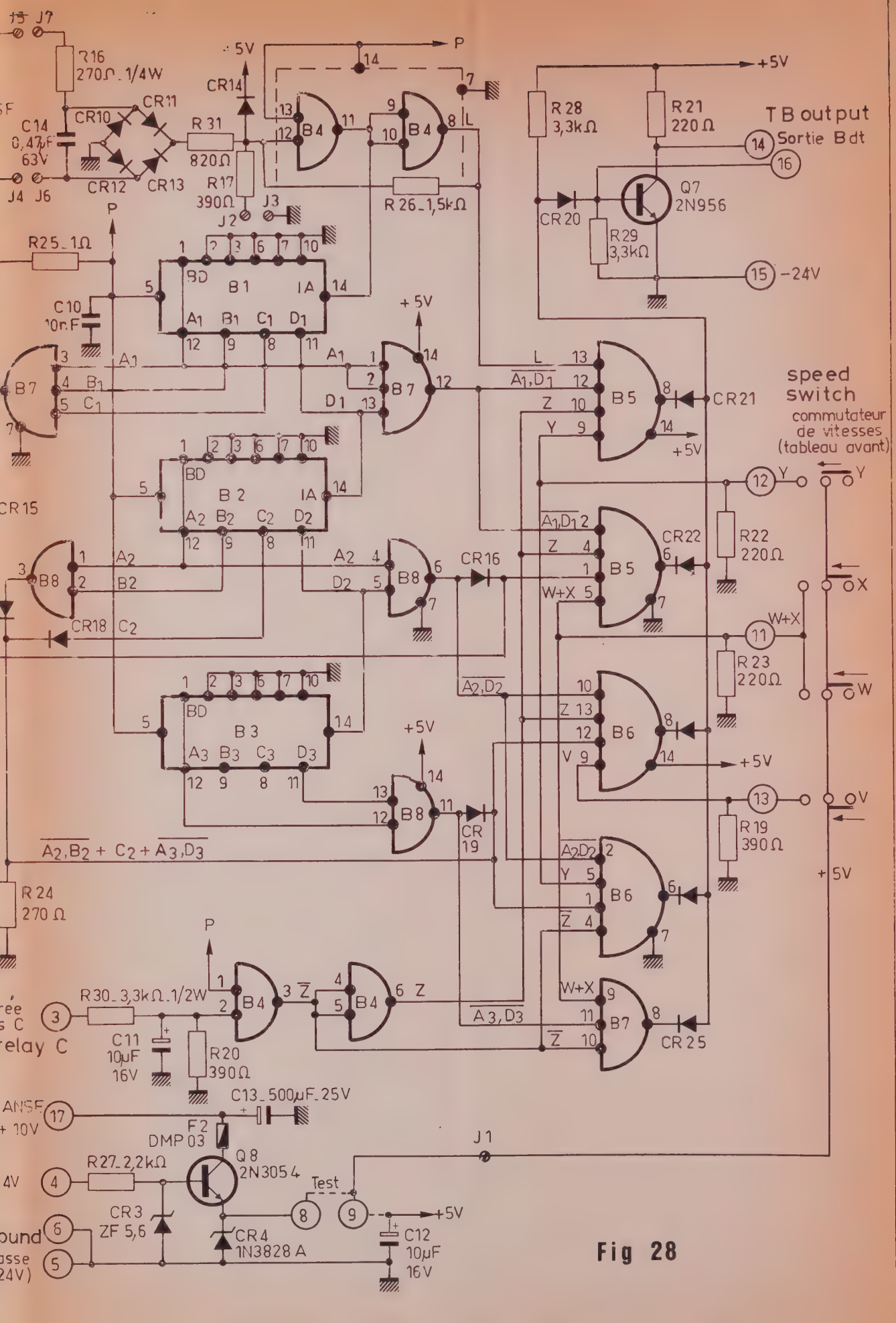

J7
R16 270Ω 1/4W
CR14
+5V
P
CR11
CR10
C14 0,47µF 63V
R31 820Ω
R17 390Ω
CR12
CR13
J4 J6
J2
J3
B4
R26 1,5kΩ
+5V
R28 3,3kΩ
R21 220Ω
TB output
Sortie Bdt
14
16
Q7 2N956
CR20
R29 3,3kΩ
15 -24V
R25 1Ω
P
C10 10nF
B1
BD
IA
A1 B1 C1 D1
B7
+5V
L
A1,D1
Z
Y
B5
CR21
+5V
speed switch
commutateur de vitesses (tableau avant)
12 Y
B2
A2 B2 C2 D2
CR15
B8
CR16
CR22
R22 220Ω
X
W+X
11
R23 220Ω
W
B3
A3 B3 C3 D3
B6
CR18
CR19
A2,D2
A2,B2 + C2 + A3,D3
13
V
R19 390Ω
+5V
R24 270Ω
R30 3,3kΩ 1/2W
3
C11 10µF 16V
R20 390Ω
A3,D3
B7
CR25
C13 500µF 25V
17
F2
DMP 03
Q8 2N3054
R27 2,2kΩ
4
Test
8
9
+5V
C12 10µF 16V
CR3 ZF 5,6
CR4 1N3828 A
6
5
J1

Fig 28

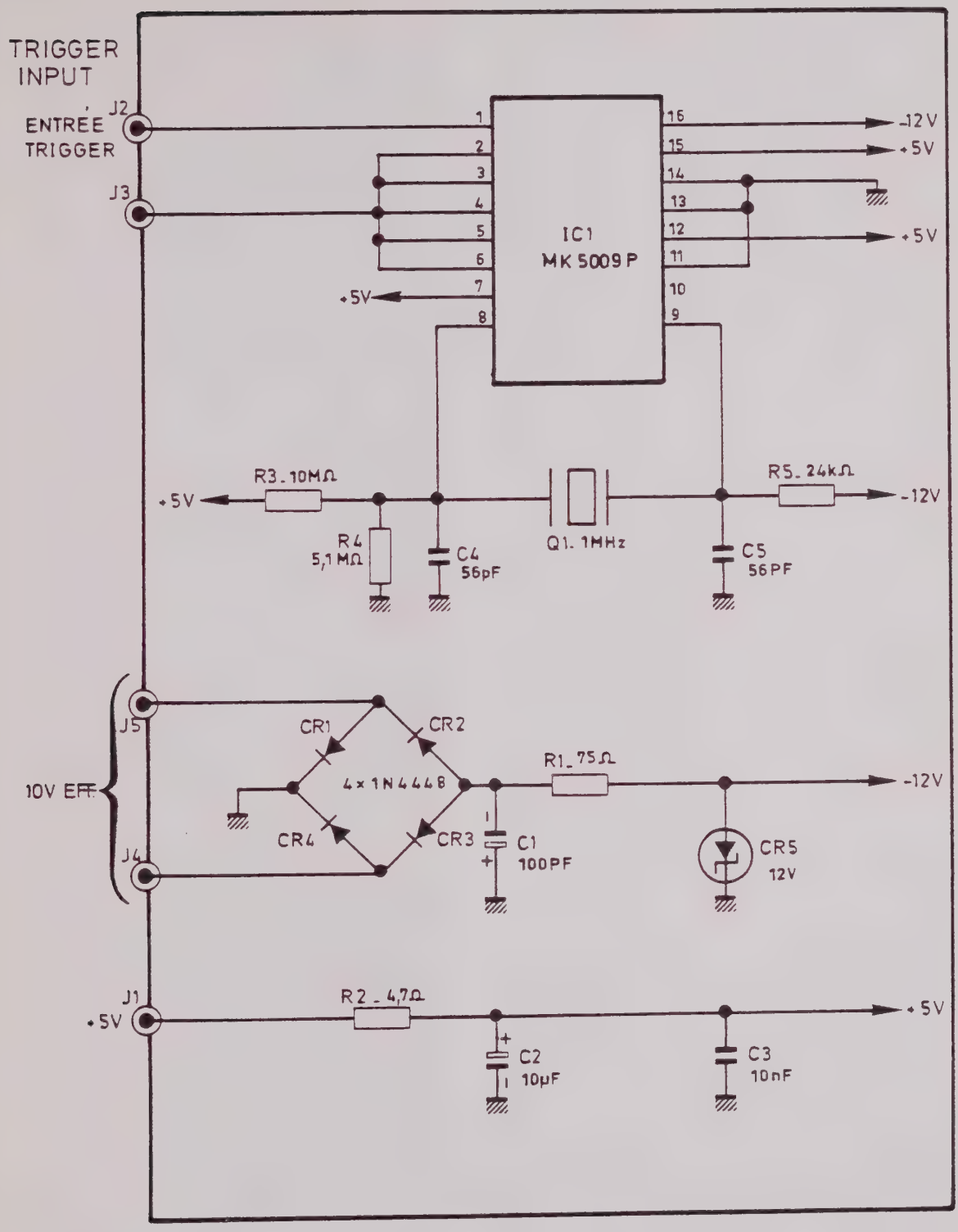

TRIGGER
INPUT
ENTREE
TRIGGER
J2
J3
IC1
MK 5009 P
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
-12V
+5V
+5V
+5V
R3_10MΩ
R4
5,1 MΩ
C4
56pF
Q1_1MHz
C5
56PF
R5_24kΩ
-12V
J5
J4
10V Eff
CR1
CR2
CR3
CR4
4x1N4448
R1_75Ω
-12V
C1
100PF
CR5
12V
J1
+5V
R2_4,7Ω
C2
10µF
C3
10nF
+5V

Fig 29

4.2.4 - Spot discrimination

4.2.4.1 - Cyclic interruption

A belt, fitted with 4 masking arms, is driven from the capstan via a set of gears. The arms interrupt the incident beam illuminating the galvanometers. This arrangement is used to identify the spots in identical order for each cycle, irrespective of galvanometer deflection at the time of discrimination, and irrespective of paper speed.

4.2.4.2 - Marginal trace numbering

A grid engraved with numbers 1 to 12 is fitted on a drum, the latter being integral with one of the drive gears. The linear speed of the grid is equal to that of paper run, so that the spot numbers are recorded clearly.

The grid is so positioned that interruption of the spot from galvanometer No. 1 corresponds to No. 1 on the grid, and likewise for galvanometer No. 12. The galvanometers are thus identified by their respective order numbers.

Each spot is interrupted every 10 cm on the paper.

4.2.5 - Event marker trace

The pulses supplied by the two event markers are used for time indexing of a sequence, during recording.

The event markers are located in the same optical plane as the galvanometer mirrors.

Powered at 24 V, they are controlled either remotely from the RC unit, or locally from the pushbutton on the rear panel of the unit (fig. 1, index 8). In the latter case, only one event marker (SP1) is controlle

Sequences are marked in the opposite margin to that used for recording spot numbers.

4.3 - Parameter matching

4.3.1 - Adaptors (fig. 30)

The adaptors are used on the direct galvanometer inputs. They provide both impedance and amplitude matching of input signals. They are contained in a compact housing (12 x 52 x 26 mm), equipped with 2 input sockets and 2 output terminals.

Four different types of adaptor are available, these being:

- OM 4510/1:

For galvanometers with electro-magnetic damping.

- OM 4510/2 :

For oil-damped galvanometers.
The consumption of an oil-damped galvanometer, type OM 4517/3, reduces the operating range of the adaptor, and the power dissipated by the latter must not exceed 1 W.

- OM 4510/3 - OM 4510/4 :

Resistive attenuator with ratios of 1/50 and 1/500, for input impedance 100 kΩ and 1 MΩ.(OM 4510/4 = Two channels).
- OM 4510/5 : atténuation ratio 1/50 ant 1/50 impedance 1 MΩ.

- OM 4510/0 :

For special user-designed applications (basic housing fitted with input sockets, output terminals, and basic printed circuit).

4.4 - Plug-in amplifiers

Each of the measurement channels can be equipped with an amplifier, with input unbalanced with respect to low, and high impedance.
The amplifier nest provides for operation as follows:

- 12 measurement channels with 6 type OA 4571/0 amplifiers
- 6 measurement channels with 6 type OM 4509/0, OM 4509/1, OM 4509/2 or OM 4509/4 amplifiers (odd channels only)
- 3 measurement channels with 3 type OM 4509/3 auxiliary units (channels 1, 5 and 9 only).

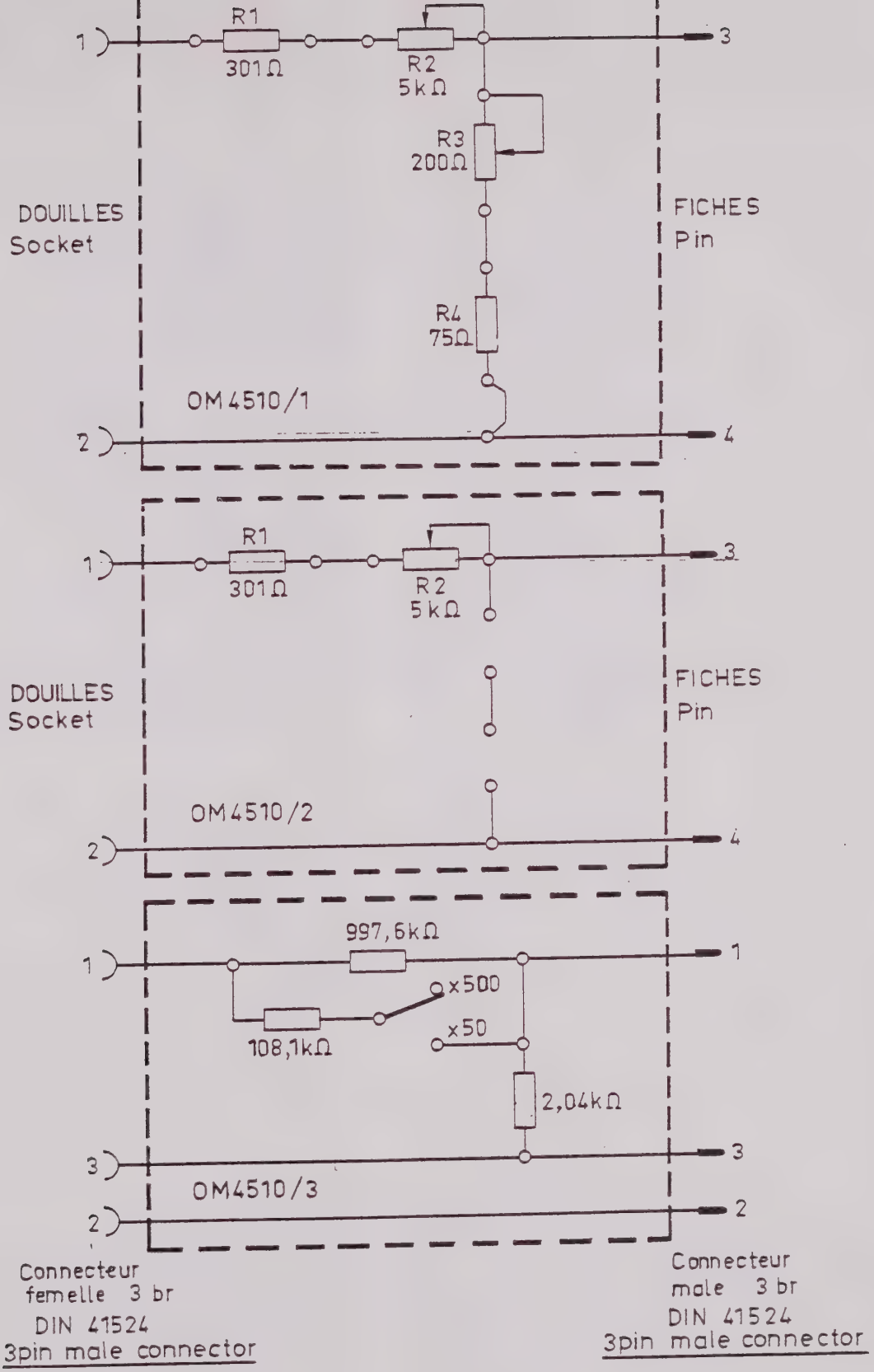
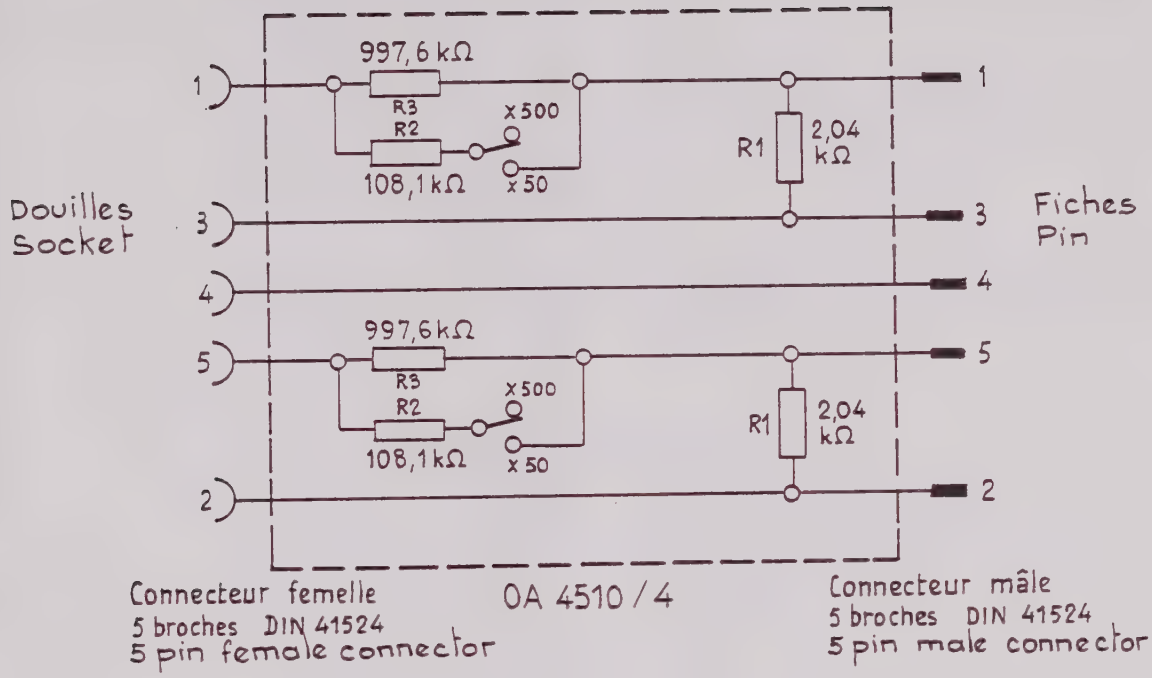

R1
301Ω
R2
5kΩ
R3
200Ω
R4
75Ω
DOUILLES
Socket
FICHES
Pin
OM4510/1
1
2
3
4
R1
301Ω
R2
5kΩ
DOUILLES
Socket
FICHES
Pin
OM4510/2
997,6kΩ
x500
x50
108,1kΩ
2,04kΩ
OM4510/3
Connecteur
femelle 3 br
DIN 41524
3pin male connector
Connecteur
male 3 br
DIN 41524
3pin male connector

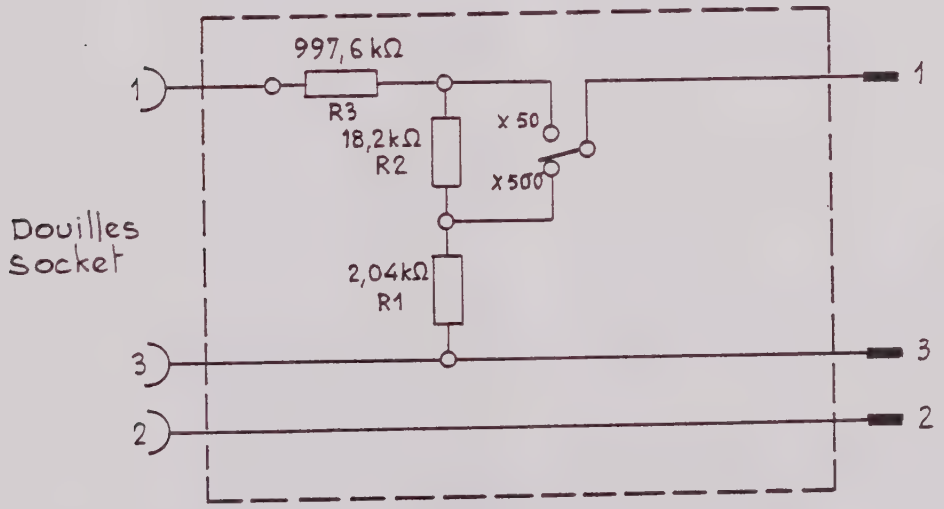
Fig 30



Connecteur femelle
5 broches DIN 41524
5 pin female connector

OA 4510 / 4

Connecteur mâle
5 broches DIN 41524
5 pin male connector



Connecteur femelle
3 broches DIN 41524
3 pin female connector

OA 4510 / 5

Connecteur mâle
3 broches DIN 41524
3 pin male connector

Fig. 30 bis

Each amplifier is presented in the form of a compact card (30 x 75 x 80 mm). Connection to power supply is via miniature sockets.

Each input is via a DIN 41524 connector. The complete amplifier is shielded, the shield being isolated from ground and connected to pin 3 of the input connector.

The card housing and shield are coated with epoxy paint, protecting the operator in the case of measurement with a high common mode voltage.

4.4.1 - Type OA 4571/0 amplifier (fig. 31)

This amplifier comprises integrated circuit IC LM308A, followed by power stage Q1-Q2, these together forming a series operational amplifier, the output current of which is proportional to input voltage.

Two slope adjustments are provided:

- By steps: 6-position selector, giving ratios of 1, 2, 5, 10, 20 and 50.
- By progressive adjustment: control R24 allows interpolation between the step adjustment values. This control gives a guaranteed variation from x 1 to x 5. Electrical zero can be adjusted on R6.

The various adjustments are accessible on the upper face of the amplifier, with the exception of the zero adjustment, preset in the factory (zero drift: < 1 mV at output).

A current limiter, comprising diodes CR7, CR8, CR9 and CR10, protects the galvanometers by limiting output current at 45 mA.

4.4.2 - Type OM 4509/2 amplifier (fig. 32)

Identical in its characteristics to the OA 4571/0, this card carries one amplifier only.

Zero adjustment is accessible on the upper face of the card housing.

4.4.3 - Type OM 4509/4 amplifier (fig. 33)

This has the same characteristics as the OM 4509/2, except that input impedance is 1 MΩ instead of 100 kΩ.

4.4.4 - Type OM 4509/1 amplifier for thermocouples (fig. 34)

Operation of this amplifier is identical to that of type OM 4509/0, except that 2 filter circuits are incorporated, for elimination of series mode components at 50 Hz, and a 121 Ω resistor for correct damping of the galvanometers. Output current is limited at 5 mA.

4.4.5 - Type OM 4509/3 auxiliary units for strain-gauges (fig. 35)

The recorder can be equipped with 1 to 4 auxiliary units, or more in cases where 1000 Ω strain-gauges are used, powered at 2 V.

These units are used in association with devices equipped with strain-gauges, and comprise 2 main parts: power supply and amplifier.

A back-off voltage is used for calibration and balancing.

Amplifier

This comprises linear integrated circuit IC1, this being an amplifier with low thermal drift, followed by a class B push-pull output stage (Q1 - Q2). These elements constitute a balanced input operational amplifier, the output current from which is proportional to input voltage.

The gain of this amplifier can be adjusted, in steps of 1, 2, 5, 10, 20 or 50, on selector S1, by modifying the negative feedback level applied to input 2 of IC1, connected to positive input. Negative input connected to input 3 of IC1, includes a summation point on the foot of R4, the voltage required for balancing and calibration, and zero adjustment of amplifier IC1 (internal adjustment), being applied to this point.

A current limiter, comprising diodes CR3, CR4, CR5 and CR6, protects the galvanometers by limiting output current at 55 mA (for oil-

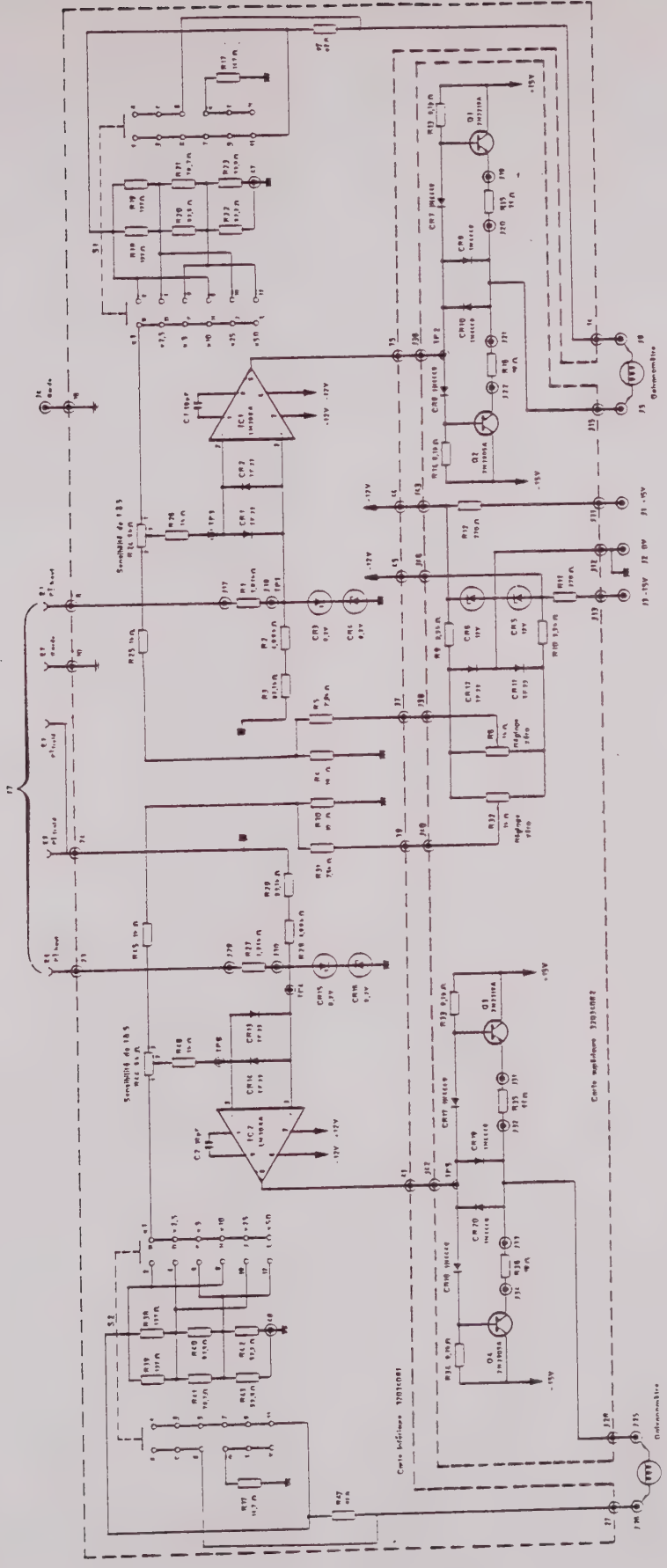
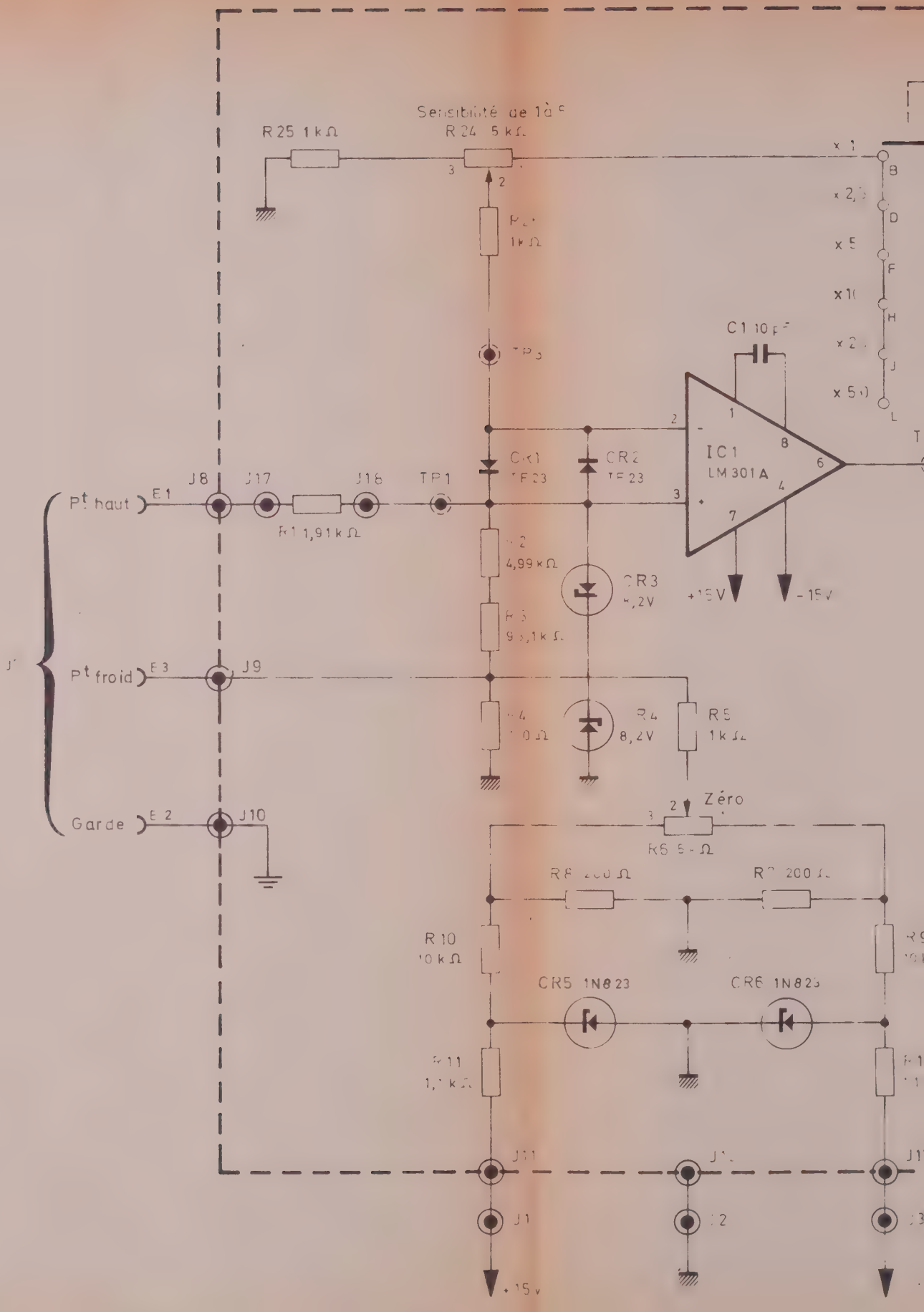


Fig 31


Sensibilité de 1à
R25 1 kΩ
R24 5 kΩ
x 1
x 2,5
x 5
x 10
x 20
x 50
C1 10 pF
IC1
LM 301 A
CR1
CR2
TP1
J8
J17
J16
Pt haut
E1
R1 1,91 kΩ
4,99 kΩ
CR3
4,2V
+15V
-15V
Pt froid
E3
J9
8,2V
R5
1 kΩ
Garde
E2
J10
Zéro
R6 5 kΩ
R10
10 kΩ
CR5 1N823
CR6 1N823
+15v

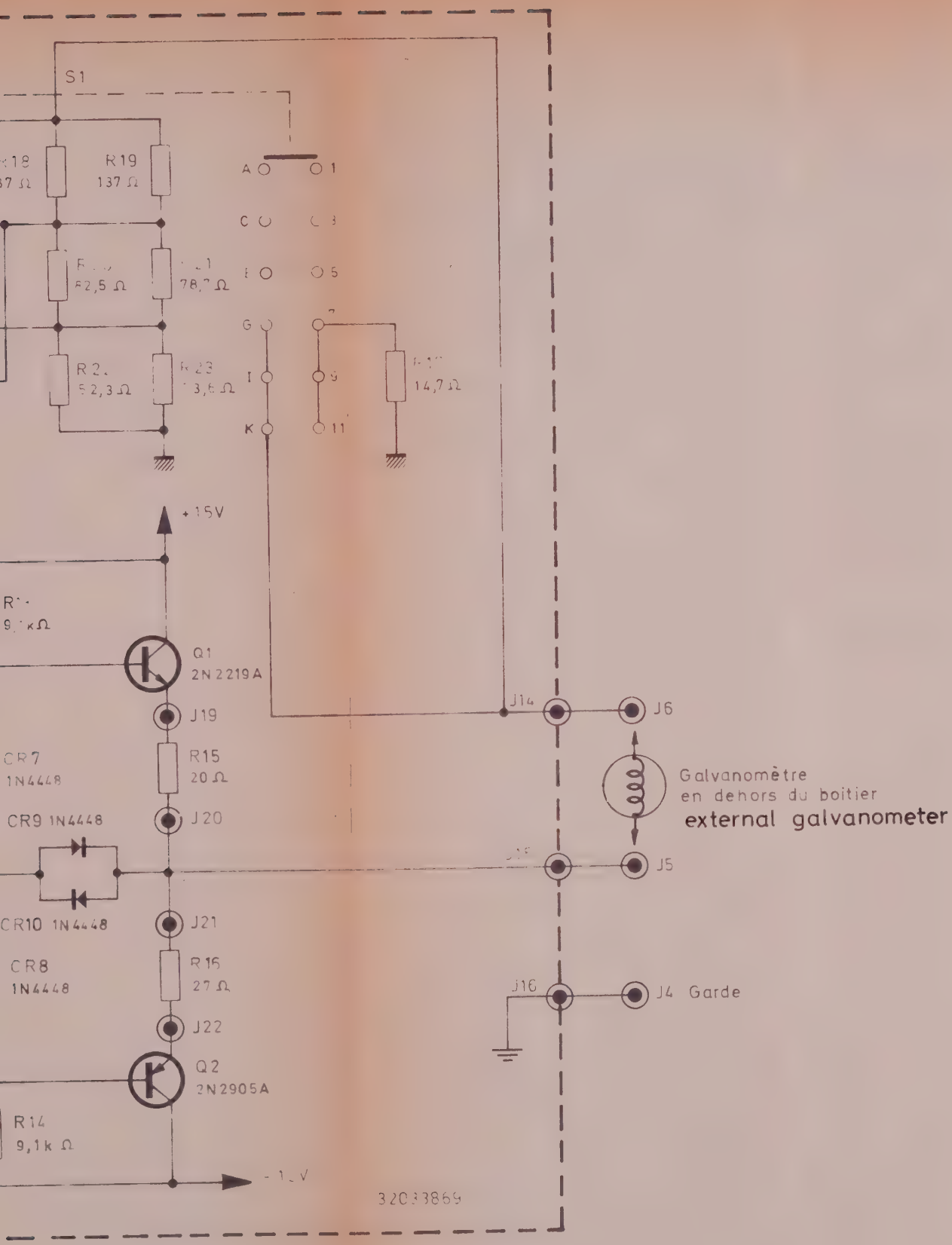
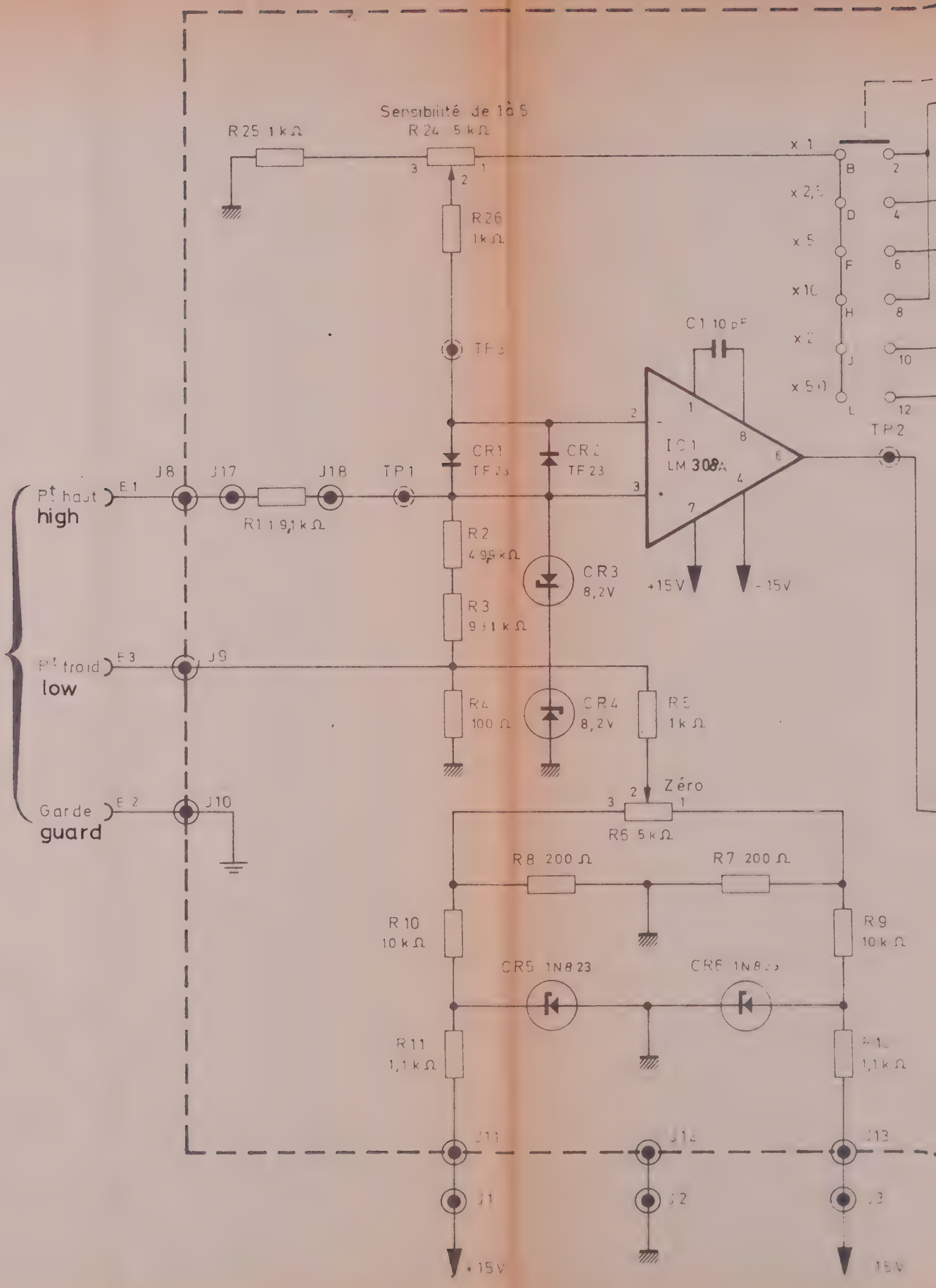

S1
R19
137 Ω
A
1
C
E
5
G
I
K
11
14,7 Ω
+15V
Q1
2N2219A
J19
J14
J6
R15
20 Ω
CR7
1N4448
CR9 1N4448
J20
Galvanomètre
en dehors du boitier
external galvanometer
J5
CR10 1N4448
J21
CR8
1N4448
R16
27 Ω
J16
J4 Garde
J22
Q2
2N2905A
R14
9,1k Ω
32033869

Fig 32


Sensibilité de 1 à 5
R25 1 kΩ
R24 5 kΩ
x 1
x 2,5
x 5
x 10
x 2
x 50
C1 10 pF
R26 1kΩ
TP3
CR1 TF23
CR2 TF23
IC1 LM 308A
TP2
+15V
- 15V
J8
J17
J18
TP1
E1
Pt haut
high
R1 9,1 kΩ
R2 4,99 kΩ
CR3 8,2V
R3 9,31 kΩ
E3
J9
Pt froid
low
R4 100 Ω
CR4 8,2V
R5 1 kΩ
Zéro
R6 5 kΩ
E2
J10
Garde
guard
R8 200 Ω
R7 200 Ω
R10 10 kΩ
R9 10 kΩ
CR5 1N823
CR6 1N823
R11 1,1 kΩ
R12 1,1 kΩ
J11
J12
J13
J1
J2
J3
+15V
-15V

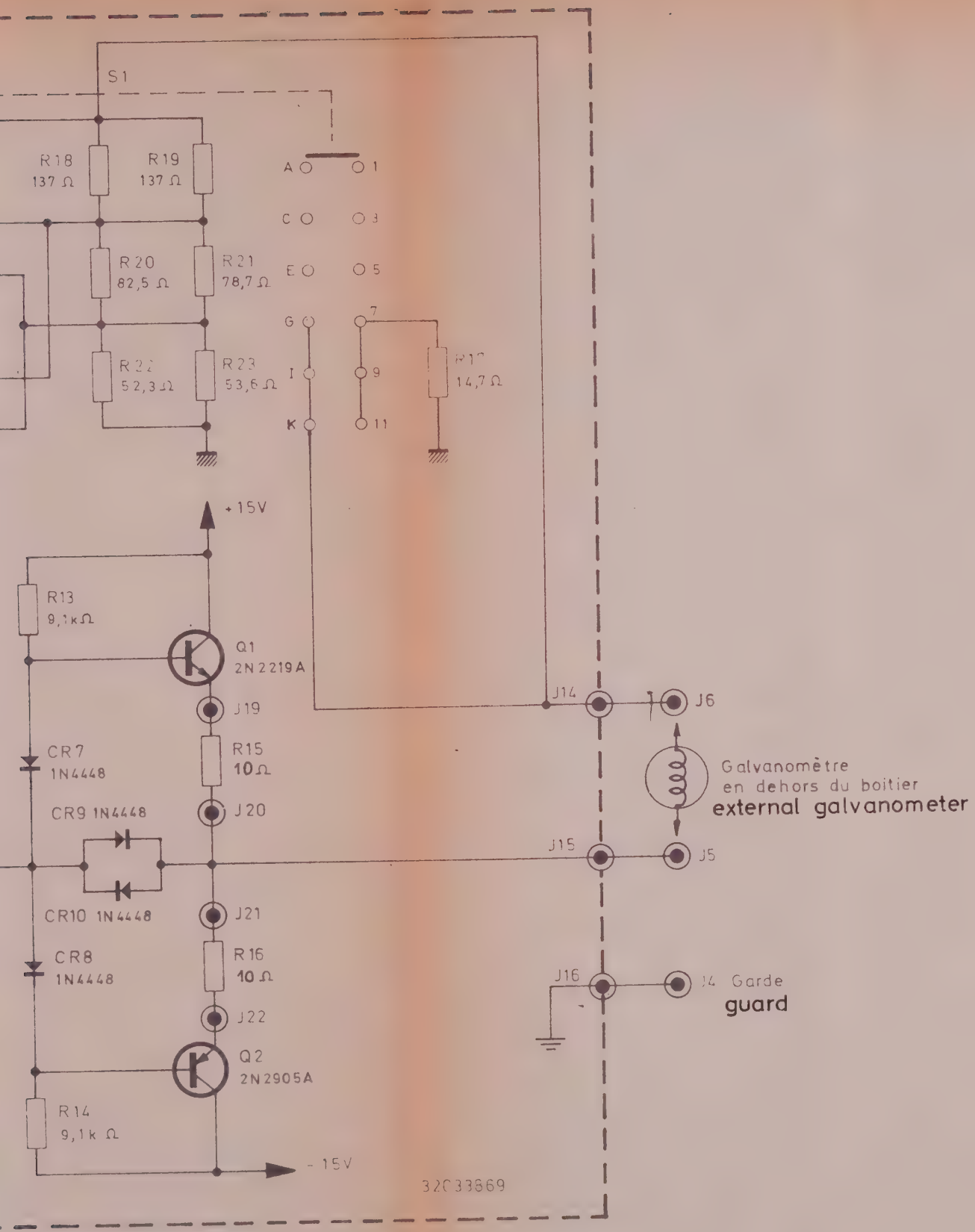

S1
R18
137 Ω
R19
137 Ω
R20
82,5 Ω
R21
78,7 Ω
R22
52,3 Ω
R23
53,6 Ω
R17
14,7 Ω
A
1
C
3
E
5
G
7
I
9
K
11
+15V
R13
9,1kΩ
Q1
2N2219A
J19
CR7
1N4448
R15
10Ω
CR9 1N4448
J20
CR10 1N4448
J21
CR8
1N4448
R16
10 Ω
J22
Q2
2N2905A
R14
9,1k Ω
- 15V
J14
J6
Galvanomètre
en dehors du boitier
external galvanometer
J15
J5
J16
J4 Garde
guard
32C33869

Fig 33

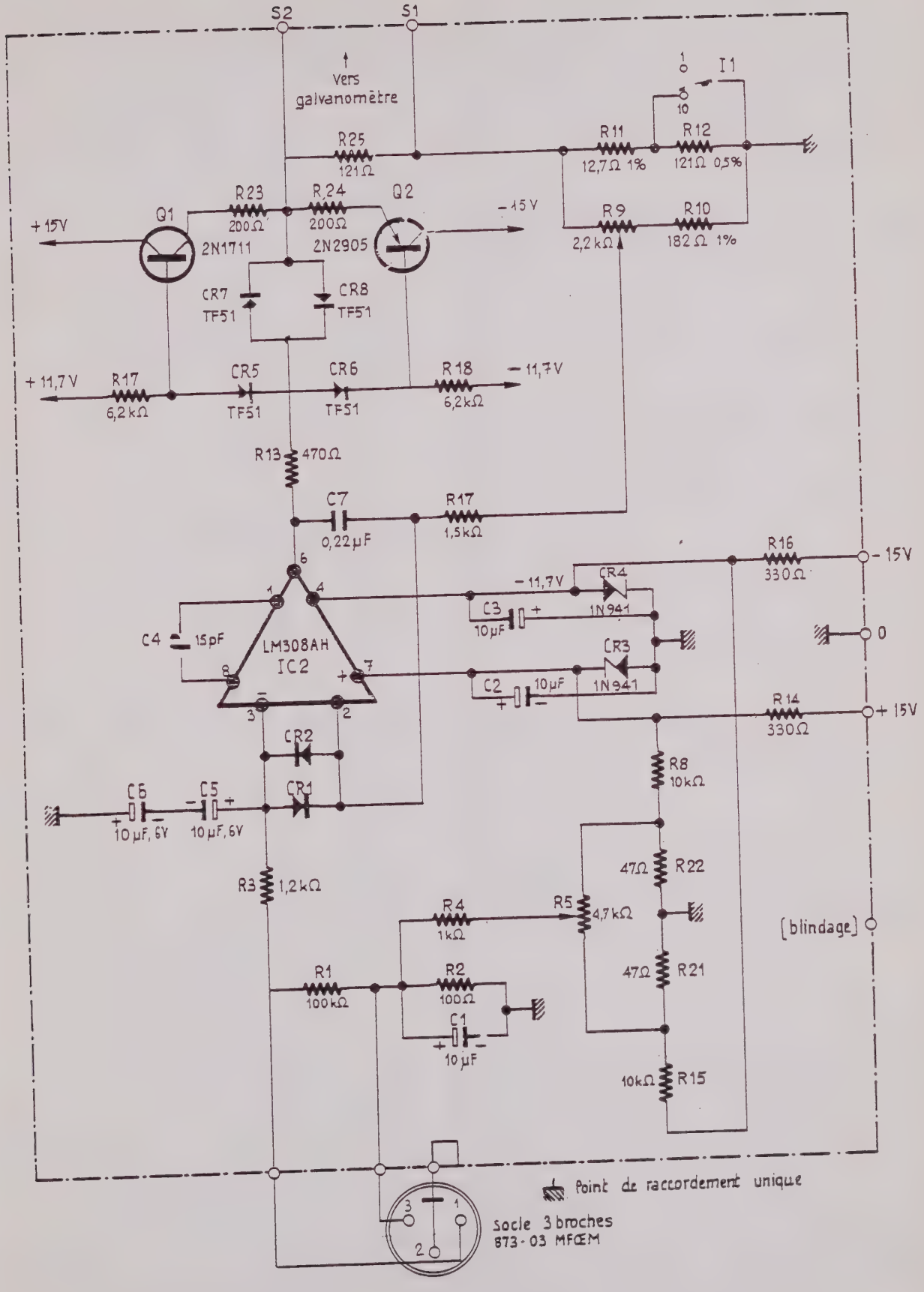

S2
S1
Vers galvanomètre
I1
R25 121Ω
R11 12,7Ω 1%
R12 121Ω 0,5%
R23 200Ω
R24 200Ω
Q1 2N1711
Q2 2N2905
+15V
-15V
R9 2,2kΩ
R10 182Ω 1%
CR7 TF51
CR8 TF51
+11,7V
R17 6,2kΩ
CR5 TF51
CR6 TF51
R18 6,2kΩ
-11,7V
R13 470Ω
C7 0,22µF
R17 1,5kΩ
R16 330Ω
CR4 1N941
C3 10µF
C4 15pF
LM308AH IC2
CR3 1N941
C2 10µF
R14 330Ω
CR2
R8 10kΩ
C6 10µF, 6V
C5 10µF, 6V
CR1
47Ω R22
R3 1,2kΩ
R4 1kΩ
R5 4,7kΩ
[blindage]
47Ω R21
R1 100kΩ
R2 100Ω
C1 10µF
10kΩ R15
Point de raccordement unique
Socle 3 broches
873-03 MFŒM

Fig 34

damped galvanometers), or 10 mA (electro-magnetically damped galvanometers).

Power supply

A regulator comprising IC3 and Q3, delivers voltage "+ U", adjustable on R33, from the positive voltage delivered by general power supply.

Voltage "+ U" drives the strain-gauge bridge and the positive balancing system (calibration).

A negative voltage is delivered by IC2, which repeats and inverts voltage "+ U", powering the negative balancing system.

In this way, calibration and balancing adjustments are independent of strain-gauge power supply voltage "U".

To guarantee the performance of this module from the thermal point of view, and also as regards balancing/calibration fidelity, the resistors connected to inputs 2 and 3 of IC1 are in thin-film technology.

4.5 - Type OA 4572/0 amplifier power supply (fig. 36)

This power supply is mounted on a detachable block, and is located in a nest at the rear of the recorder (fig. 21).

This block is itself powered from the 24 V DC used for the recorder ancillaries. This voltage is reduced and chopped, so as to supply the transformers corresponding to the amplifiers in use. This voltage is rectified and filtered.

Each amplifier is powered at $\pm$ 15 V, isolated from 24 V supply.

The power supply block also delivers the reference voltages required for amplifier calibration. These voltages (10, 100 and 1000 mV) are regulated using a Zener reference diode.

4.6 - Paper run time control unit (fig. 37)

Astable multivibrator IC1 delivers a frequency which can be adjusted by steps between 10 and 1 Hz, adjustment being on contactor switch S1. This frequency is then divided by 10 and 100, by IC2 and IC3.

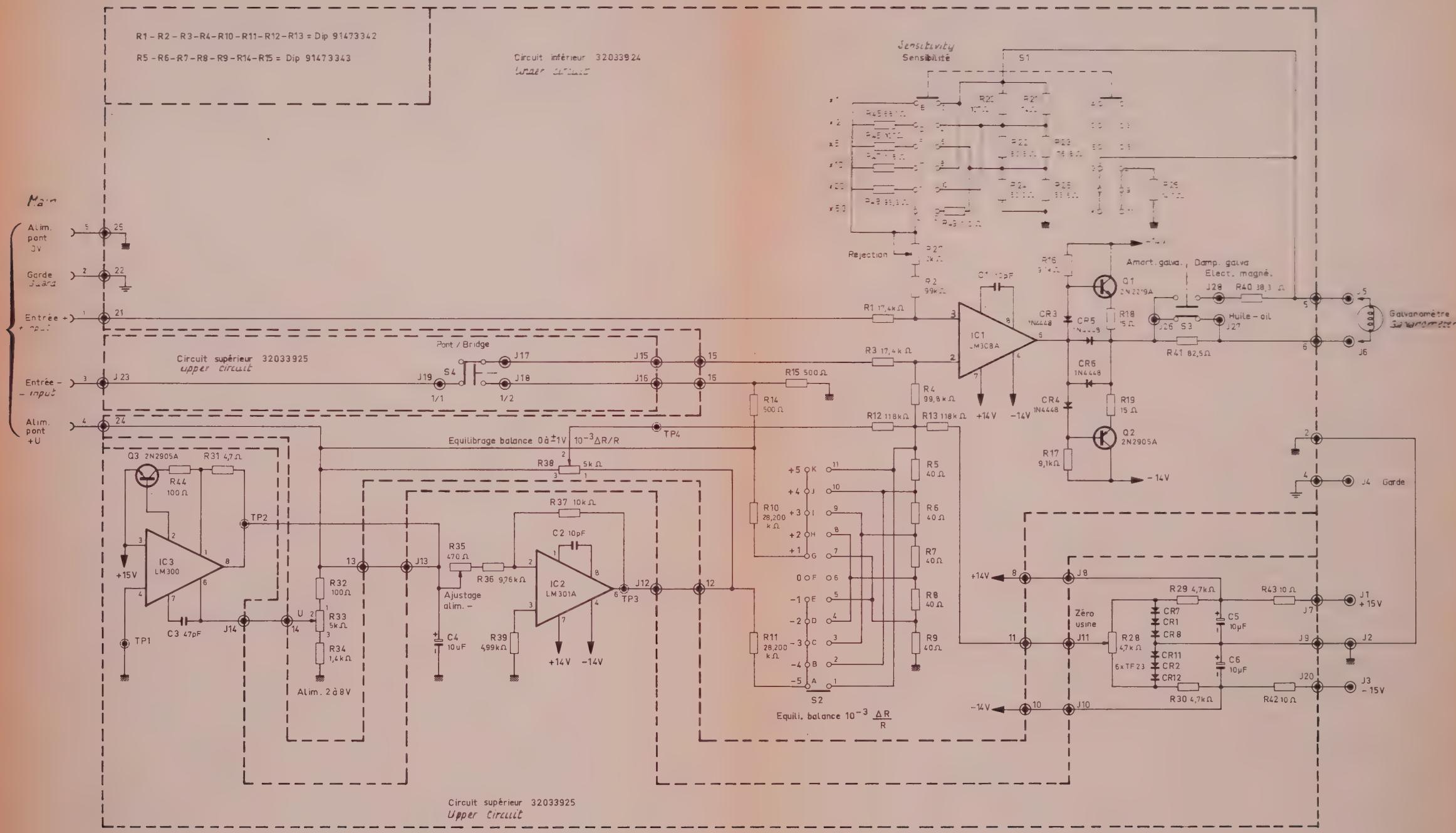


Fig 35

SP031048

When one of the recorder drive system contacts is closed for a few moments (contact closed between pins 1 and 4 of J10), relay K1 locks and system IC1, IC2 and IC3 counts.

At the end of a period corresponding to 10 (x 1) or 100 (x 10) times that of the multivibrator, as determined by the position of switch S2, transistor Q5 conducts, transistor Q6 is cut off, relay K1 is released and the recorder stops.

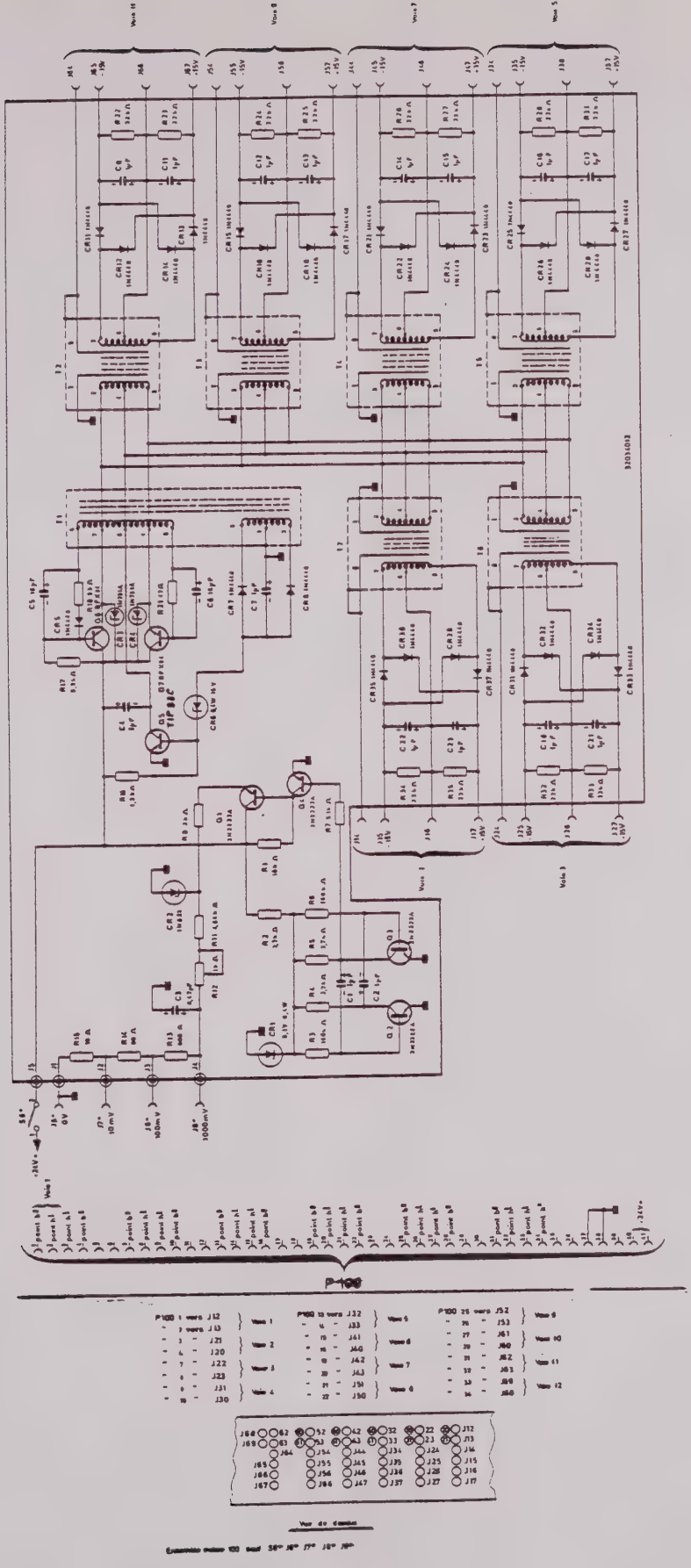
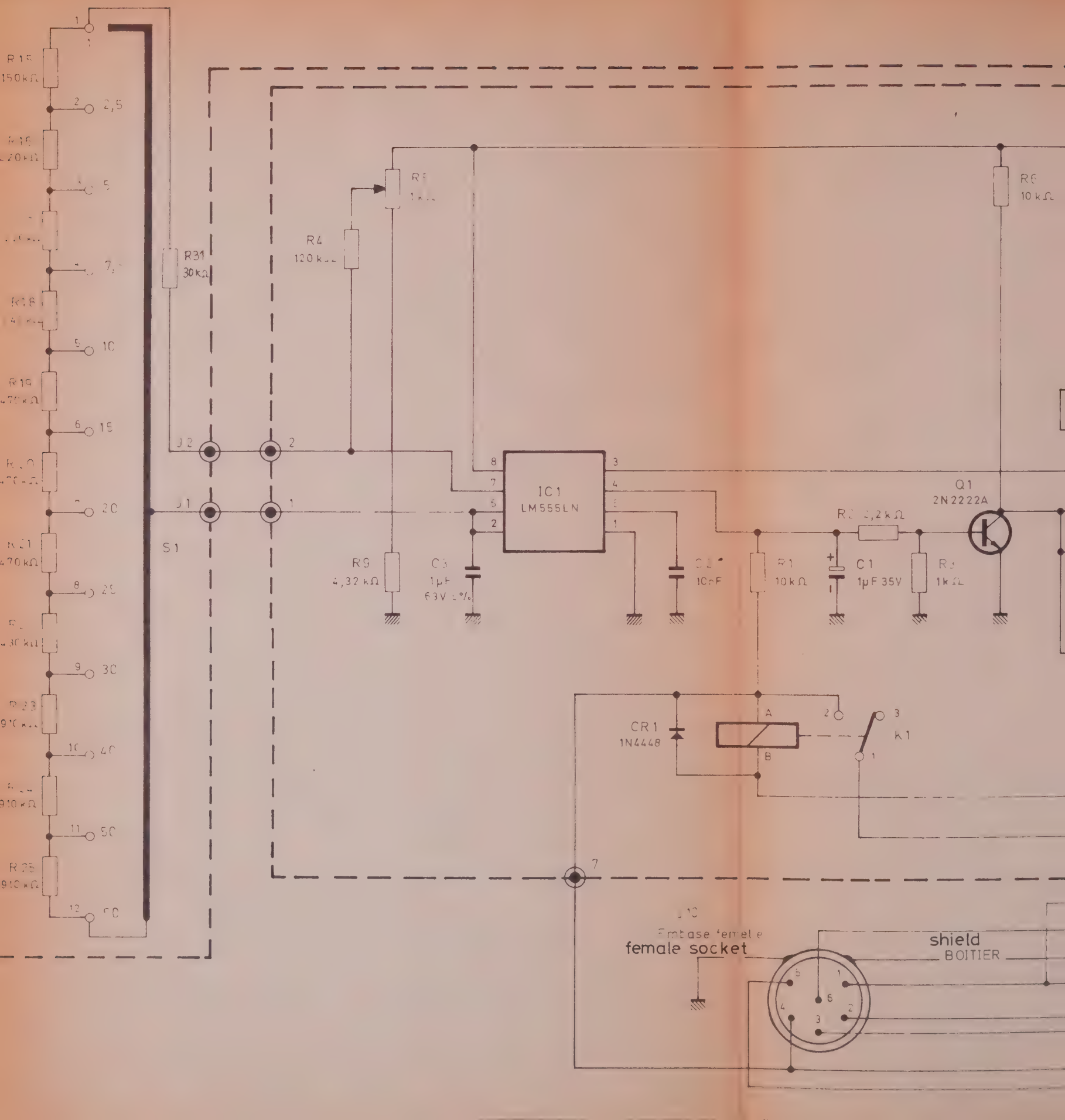


Fig 36


R31
30kΩ
R4
120kΩ
R5
1kΩ
R6
10kΩ
J2
J1
S1
IC1
LM555LN
Q1
2N2222A
R9
4,32kΩ
C3
1µF
63V
C2
10nF
R1
10kΩ
C1
1µF 35V
R7
1kΩ
CR1
1N4448
K1
A
B
female socket
shield
BOITIER

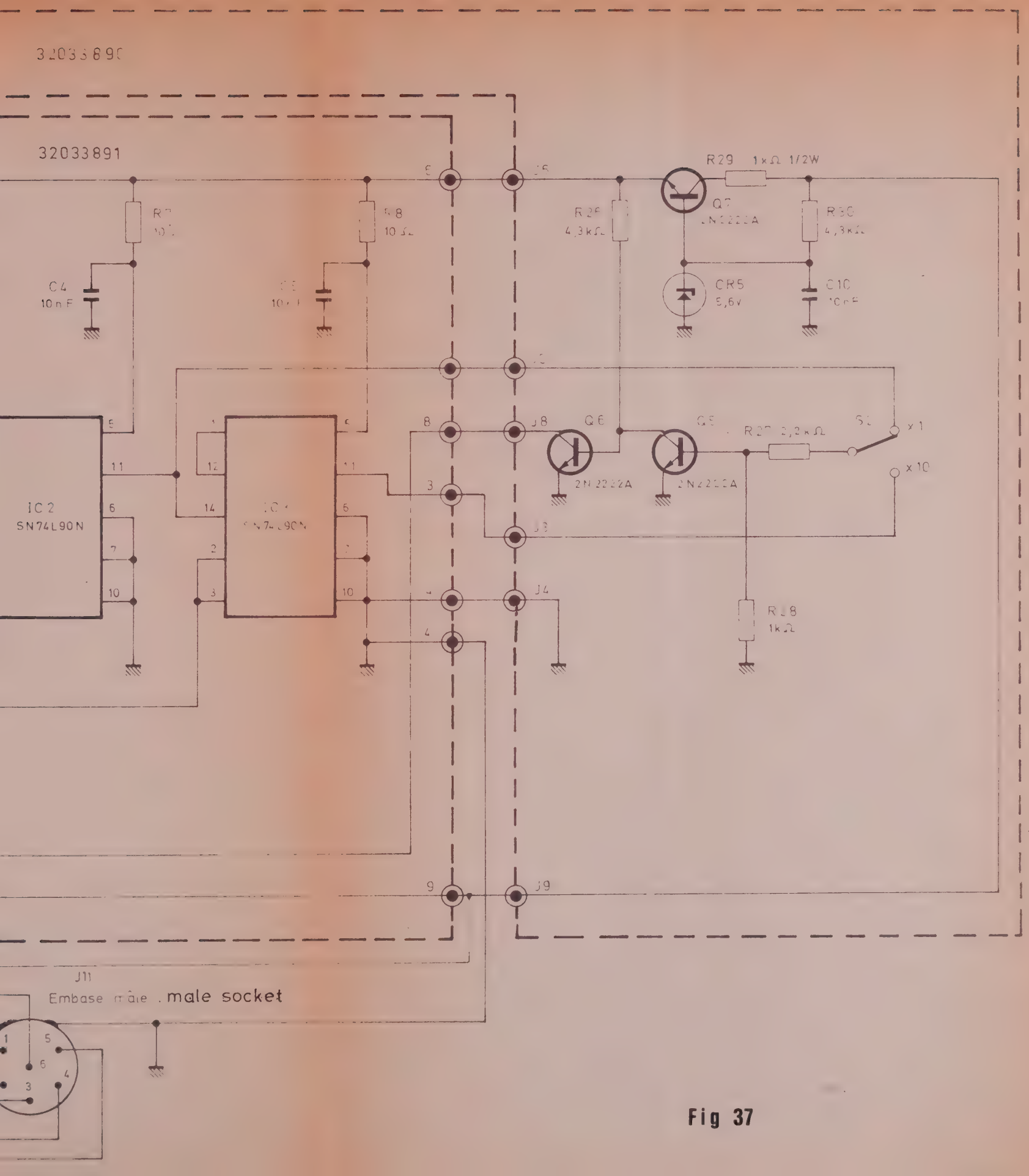

32033890
32033891
R29 1kΩ 1/2W
Q7
2N2222A
R30
4,3kΩ
R28
4,3kΩ
CR5
5,6v
C10
C4
10nF
R8
10Ω
IC2
SN74L90N
IC1
SN74L90N
Q6
2N2222A
Q5
2N2222A
R27 2,2kΩ
S2
x1
x10
R18
1kΩ
J8
J3
J4
J9
J11
Embase mâle . male socket

Fig 37

Bloc magnétique (vue coté câblage) Magnetic block wiring side

Vue intérieure carte interconnexions Interconnection card internal view

Channel Voies 1 2 3 4 5 6 7 8 9 10 11 12

Supérieur High

Intérieur Low

Gauche Left

Droite Right

G

Carte fond arrière Interconnection card

200

P100

Carte régulation Régulator card

SP2

SP1

Marqueurs d'évènement Event markers

+24V

J3

Vue de dessus (alimentation des amplis) View from above (amplifiers P.S.)

100

1000mV

100mV

10mV

0V

S6

Alimentation des amplis 0A4572/0

Amplifiers P.S.

Chauffage bloc thermostaté

With Avec

Sans Without

S10

Heat magnetic block

Secteur Mains

S3

Secteur Mains

S7

S8

115

130

230

245

F1.2A

F2.1A

15V

115V

45V

220V

24V

10V

J42

J43

J44

J45

J46

J47

Ventilateur

500

Carte Lumière

Ligh power card

HBO 50W/3

L1

L2

S6302

J34 J35 J23 J24

Ground magnetic block

Masse bloc magnétique

Switching card

Carte Aiguillage 300

yellow black jaune noir

rouge noir red black

vert noir Green black

yellow jaune

red rouge

Green vert

Papst motor Moteurs Papst SM42.65.4. B310.220E

3,9µF

6,8µF

marche Run

S4

Motor stop Moteur arrêt

Run Marche

Boite de vitesse Gear box

K1

K2

K3

B

blanc white

rouge red

CR77

CR76

CR74

CR72

CR71

CR73

CR70

CR75

CR67

CR68

CR69

S9

Chargement Loading

S2 Multiplicateur de vitesse : 1x100

Speed switch 1/100

S1

Vitesses Speeds

Shield blindage

+24V

1→x100

Motor relay relais moteur

NC

Top 2

Top 1

6pin Jeader pin N° Numéros des cosses prise JAEGER 6 broches

Poignée de télécommande R.C. unit

J2

Télécommande R.C.

S5 S.P

Transformateur d'alimentation

P.S. transformer

400

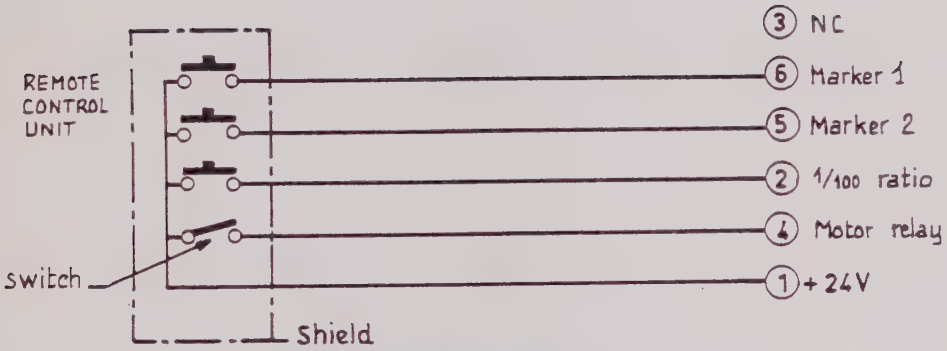
Carte base de temps

T.B. card

P400

14 = Numéro de fil wires Nr

Fig. 38



JAEGER connector

Fig. 39

MAINTENANCE

5 - MAINTENANCE

Maintenance of the OM 4502 portable UV recorder is restricted to the following operations:

- cleaning of the recorder
- lubrication of the gearbox
- replacement of the light sources.

5.1 - Cleaning the recorder

According to operating conditions, the recorder must be cleaned every 100 or 1000 hours. Cleaning must be undertaken whenever spot brightness decreases.

Proceed as follows:

- Remove the top cover (fig. 19, index 15).
  Remove the roll of chart paper. Turn the recorder over and remove the lower cover.

- Place the recorder on its side.

- Clean the inside of the recorder, using a small pair of bellows.

The various optical elements - intermediate mirror, galvanometer lenses, lining strips - should be cleaned with a fine-hair brush or piece of dry cotton rag (take great care not to press on the reflecting surfaces).

5.2 - Lubrication of the gearbox

Normally after 100 hours of continuous operation, or 200 hours intermittent operation, put one drop of type SAE 20 oil on each of the clutch springs.

5.3 - Replacing the light sources

5.3.1 - Replacing the UV lamp

The average lifetime of the UV lamp is 200 hours under normal operating conditions (minimum of 2 hours operation after each start).

Lifetime is cut by half if average operating time after each start is only 20 minutes.

Avoid successive operating periods of less than 15 minutes.

If the lamp starts to flicker, independantly of any failure in line supply, and after the normal stabilization period, this indicates that the lamp has exceeded its effective lifetime. This also applies when the spot appears in the form of a strip of light.

Proceed as follows to replace the lamp:

- Allow the recorder to cool down.
- Open the trap (fig. 19, index 17), giving access to the UV lamp.
- Fully unscrew the lamp height-adjustment screw (fig. 8, index 1).
- Withdraw the UV lamp bracket (fig. 23, index 3) from its housing (index 2).
- Depress the ejector pushbutton (fig. 23, index 5).
- Withdraw the lamp by means of the lower socket (index 7), via the orifice (index 6).
- Extract the old lamp from the socket, and replace with a new one.
- Reassemble the various components, proceeding in reverse order to that indicated above.

IMPORTANT NOTE

During these operations, it is essential to avoid placing the fingers on the lamp bulb, otherwise grease will be deposited on the latter. Should this occur accidentally, the bulb must be cleaned with 90° alcohol. If not removed, the grease will burn and the quality of the light source and image will be impaired.

Having replaced the lamp bracket:

- Screw up the height-adjustment screw by about 10 turns.
- Carry out height-adjustment of the lamp, following the indications given in § 4.2.1.

5.3.2 - Replacing the flashlamp

Normal lifetime for a flashlamp corresponds to approximately 20 million flashes. Proceed as indicated in § 4.8.1.2.

5.4 - Maintenance of the light source unit

As a result of the high temperature involved, and the UV radiation and ozone produced, it is advisable to replace either the mercury vapour lamp supply connections, or the lamp support assembly, after 1000/2000 hours of operation.

The degree of wear incurred can be assessed from the condition of the supply wires to the upper socket.

NOTE: Take particular care to observe correct connection, as follows:

- Lower cap = +
- Upper cap = -

If polarity is accidentally inverted, the lamp will be destroyed immediately.

NOMENCLATURES

CARTE BASE DE TEMPS CODEE OM 4515/0

OM 4515/0 CODED TIME BASE

Repère ITEM	Désignation COMPONENT			Référence Reference
	INTEGRATED CIRCUIT			
	CIRCUIT INTEGRE	7490		
B1	" "	7490		95232012
B2	" "	7490		95232012
B3	" "	7490		95232012
B4	" "	7400		95232005
B5	" "	7420		95232007
B6	" "	"		95232007
B7	" "	7410		95232006
B8	" "	7400		95232005
TR7	TRANSISTOR	2N	956	95212113
TR8	"	2N	3054	95212232
Z3	DIODE			95222560
Z4	"	1N	3828A	95222861
D10	"	1N	4448	95222854
D11	"	1N	4448	95222854
D12	"	1N	4448	95222854
D13	"	1N	4448	95222854
D14	"	1N	4448	95222854
D15	"	1N	4448	95222854
D16	DIODE	1N	4448	95222854
D17	" "	1N	4448	95222854
D18	" "	1N	4448	95222854
D19	" "	1N	4448	95222854
D20	" "	1N	4448	95222854
D21	" "	1N	4448	95222854
D22	" "	1N	4448	95222854
D23	" "	1N	4448	95222854
D24	" "	1N	4448	95222854
D25	" "	1N	4448	95222854

CARTE BASE DE TEMPS CODEE OM 4515/0

OM 4515/0 CODED TIME BASE

Repère ITEM	Désignation COMPONENT				Référence Reference
	RESISTOR RESISTANCE				
R16	"	270Ω	5%	0,25W	95612021
R16	"	270Ω	5%	0,5 W	95612232
R17	"	390Ω	5%	0,25W	95612024
R18	"	390Ω	5%	0,25W	95612024
R19	"	390Ω	5%	0,25W	95612024
R20	"	390Ω	5%	0,25W	95612024
R21	"	220Ω	5%	0,25W	95613312
R22	"	220Ω	5%	0,25W	95613312
R23	"	220Ω	5%	0,25W	95613312
R24	"	270Ω	5%	0,25W	95612021
R25	"	1 Ω	5%	0,25W	95613702
R26	"	1,5K	5%	0,25W	95613288
R27	"	2,2K	5%	0,25W	95612009
R28	"	3,3K	5%	0,25W	95613292
R29	"	3,3K	5%	0,25W	95613292
R30	"	3,3K	5%	0,25W	95612251
R31	"	820Ω	5%	0,25W	95612029
	CAPACITOR				
C10	CAPACITE	0,01MF		40 V	95552252
C11	"	10MF	20%	16 V	95562274
C12	"	10MF	20%	16 V	95562274
C13	"	500MF		25 V	95561803
C14	"	0,47MF	20%	63 V	95572102
	FUSE				
F2	FUSIBLE RAPIDE	0,3A		3,5 x 10	96112164
	LAMP LAMPE OM 4520/1				32445201

CARTE BASE DE TEMPS PILOTEE PAR QUARTZ OM 4521/0

OM 4521/0 CRYSTAL DRIVEN TIME BASE

Repère ITEM	Désignation COMPONENT			Référence Reference
	INTEGRATED CIRCUIT			
IC1	CIRCUIT INTEGRE MK 5009P			95232579
CR1	DIODE 1N 4448			95222854
CR2	" " "			95222854
CR3	" " "			95222854
CR4	" " "			95222854
CR5	"		12V 5MA	95225548
	RESISTOR			
R1	RESISTANCE 75Ω	5%	0,25W	95618811
R2	" 4,7Ω	5%	0,25W	95613328
R3	" 1 MΩ	5%	0,5 W	95612297
R4	" 5,1MΩ	5%	0,5 W	95612310
R5	" 24KΩ	5%	0,25W	95613315
	CAPACITOR			
C1	CAPACITE 100µF	50%	25V	95561802
C2	" 10µF	20%	16V	95562274
C3	" 0,01µF		40V	95552252
C4	" 56PF	5%	63V	95543014
C5	" 56PF	5%	63V	95543014
	QUARTZ 1MHz			95362060

CARTE LUMIERE

LIGHT SOURCE POWER CARD

Repère ITEM	Désignation COMPONENT			-Référence Reference
	TRANSISTOR			
Q1	"	2N	2219 A	95213231
Q2	"	2N	2219 A	95213231
Q3	DIODE	BRY	54	95227504
Q4	TRANSISTOR	BFX	39	95214534
Q5	"	BFX	34	95217043
Q6	"	MJ	3772	95212521
Q7	TRANSISTOR	BTW	27	95216017
Q8	DIODE	IN	5760	95220104
	DIODE BRIDGE			
CR1	PONT DE DIODES W 06			95225038
CR2	DIODE	MCP 6		95225027
CR3	"	MCP 6		95225027
CR4	"	ZP 8,2		95222546
CR5	"	1N 4448		95222854
CR6	"	1N 4448		95222854
CR7	"	1N 4448		95222854
CR8	"	1N 647		95222103
CR11	"	1N 3880R		95222864
CR12	"	10 V 5 mA		95222555
CR13	"	1N 3942		95222844
CR14	"	1N 3942		95222844
CR15	"	1N 3942		95222844
CR16	"	1N 3942		95222844
CR17	"	1N 3942		95222844
CR18	"	1N 4448		95222854
CR19	"	10 V 5 mA		95222555
CR20	"	1N 4004		95222849
CR21	"	10 V 5 mA		95222555

CARTE LUMIERE

LIGHT SOURCE POWER CARD

(suite)

Repère ITEM	Désignation COMPONENT	Référence Reference
	RESISTOR RESISTANCE	
R1	" 1 kΩ 5 % 0,25 W	95613286
R2	" 357 Ω 1 % 0,25 W	95619631
R4	" 2,43 kΩ 1 % 0,25 W	95619711
R5	" 4,7 kΩ 5 % 1 W	95611438
R6	" 51 Ω 5 % 0,25 W	95612005
R7	" 4,7 kΩ 5 % 7 W	95632160
R8	" 0,25 Ω 1 % 6 W	95642900
ou		
R8	" 0,25 Ω 1 % 3 W	95660336
R11	" 4,7 kΩ 5 % 0,25 W	95613294
R12	" 68 kΩ 5 % 0,5 W	95612276
R13	" 82 kΩ 5 % 0,25 W	95613317
R14	" 1 kΩ 5 % 0,25 W	95613286
R15	" 1 kΩ 5 % 0,25 W	95613286
R16	" 562 Ω 1 % 0,25 W	95619650
R17	" 15 kΩ 1 % 0,25 W	95619787
R18	" 1,5 kΩ 5 % 8 W	95632028
R19	" 3,3 kΩ 5 % 0,25 W	95611059
R20	" 47 Ω 5 % 0,25 W	95612004
R21	" 100 Ω 5 % 0,25 W	95612006
R22	" 4,7 Ω 5 % 3 W	95632056
R23	" 10 kΩ 5 % 0,25 W	95612013
	POTENTIOMETER	
R3	POTENTIOMETRE 220 Ω 20 % 0,75 W	95713097
	CAPACITOR CONDENSATEUR	
C1	" 820 µF 80 V	95562200
C2	" 0,047 µF 20 % 100 V	95577190
C3	" 2200 µF 40 V	95562185

CARTE LUMIERE

LIGHT SOURCE POWER CARD

(suite)

Repère ITEM	Désignation COMPONENT	Référence Reference
	CAPACITOR CONDENSATEUR	
C4	" 0,68 µF 20 % 400 V	95577251
C5	" 0,1 µF 20 % 400 V	95577189
C6	" 330 µF 63 V	95562165
C7	" 1 µF 20 % 400 V	95577147
C8	" 0,047µF 20 % 100 V	95577190
	PULSE TRANSFORMER	
T1	TRANSFO IMPULSION 350 V	95442086
T2	TRANSFO (P18888) TRANSFORMER	12018256
F1	FUSIBLE RAPIDE 0,1 A FAST FUSE	96112214
K1	RELAIS MS 13 RELAY	94612190

ALIMENTATION OA 4572/0

OA 4572/0 AMPLIFIERS AND AUXILIARY POWER SUPPLY

Repère ITEM	Désignation COMPONENT	Référence Reference
	CONNECTOR	
J6	CONNECTEUR FEM 1C	94432165
J7	" " 1C	94432197
J8	CONNECTEUR JAUNE yellow	94432168
J9	CONNECTEUR MAL 1C	94432166
J12	CONNECTEUR FEM 1C	94432020
à		
J69	" "	94432020

CARTE DE L'ALIMENTATION OA 4572

CARD OF THE OA 4572 POWER SUPPLY

Repère Item	Désignation Component				Référence Reference
Q1 à Q4	TRANSISTOR	2N	2222A		95212216
Q5	"	BD	245C		95217037
Q6 - Q7	"	BFX	34		95217043
CR1	DIODE ZENER				95222559
CR2	" "	1N	823		95222107
CR3-CR4	" "	1N	731A		95221262
CR5	"	1N	4448		95222854
CR6	" "	15 V	15 mA		95222563
CR7-CR8		1N	4448		95222854
CR11 à	"	1N	4448		95222854
CR18					
CR21 à CR28	"	1N	4448		95222854
CR31 à CR38	"	1N	4448		95222854
	RESISTOR RESISTANCE				
R1	"	10 kΩ	5 %	0,25 W	95612013
R2	"	2,7 kΩ	5 %	0,25 W	95613290
R3		150 kΩ	5 %	0,25 W	95613299
R4 - R5	"	2,7 kΩ	5 %	0,25 W	95613290
R6	"	150 kΩ	5 %	0,25 W	95613299
R7	"	5,1 kΩ	5 %	0,25 W	95613326
R8	"	2 kΩ	5 %	0,25 W	95618818
R11	"	4,64 kΩ	1 %	0,12 W	95619738
R13	"	900 Ω	0,5 %	0,12 W	95614100
R14	"	90 Ω	0,5 %	0,12 W	95614099
R15	"	10 Ω	0,5 %	0,12 W	95660202
R16		1,2 kΩ	5 %	0,5 W	95612244
R17	"	3,3 kΩ	5 %	0,25 W	95613292

CARTE DE L'ALIMENTATION OA 4572

CARD OF THE OA 4572 POWER SUPPLY

Repère Item	Désignation Component				Référence Reference
	RESISTOR				
	RESISTANCE				
R18	"	33 Ω	5 %	0,25 W	95613303
R21	"	47 Ω	5 %	0,25 W	95612004
R22 à R28	"	22 kΩ	5 %	0,25 W	95612015
R31 à R35	"	22 kΩ	5 %	0,25 W	95612015
	POTENTIOMETER				
	POTENTIOMETRE				
R12	"	1 kΩ	5 %	0,6 W	95750093
	CAPACITOR				
	CONDENSATEUR				
C1 - C2	"	1 µF	35 V	35 V	95560035
C3	"	0,47 µF	10 %	35 V	95560434
C4	"	3,3 µF		35 V	95560021
C5 - C6	"	15 µF	20 %	20 V	95562020
C7 - C8	"	1 µF		35 V	95560035
C11 à C18	"	1 µF		35 V	95560035
C21 à C23	"	1 µF		35 V	95560035
	TRANSFORMER				
	TRANSFORMATEUR				
T1	"	P 18497			12018497
T2 à T7	"	P 18258 PA			12018258
	CABLE ACCESSORIES				
	ACCESSOIRES CABLE				
	COSSE SOUDEE	MFDEM 519			94340031
	RADIA ROND D12	EUROP TXBF032025B			94460013
J1 à J5	PLOT TYPE A	S5003			94333303

CARTE INFERIEURE AMPLIFICATEUR DOUBLE OA 4571/0

OA 4571/0 TWIN AMPLIFIER LOWER CARD

Repère ITEM	Désignation COMPONENT				Référence Reference
					SP031096
	INTEGRATED CIRCUIT				
IC1	CIRCUIT INTEGRE	LM 308AH			95242532
IC2	" "	LM 308AH			95242532
CR1	DIODE	TF 23			95222200
CR2	"	TF 23			95222200
CR3	"	ZP 8,2			95222546
CR4	"	ZP 8,2			95222546
CR13	"	TF 23			95222200
CR14	"	TF 23			95222200
CR15	"	ZP 8,2			95222546
CR16	"	ZP 8,2			95222546
	RESISTOR				
R1	RESISTANCE	1,91K	1%	0,25W	95619701
R2	"	2,43K	1%	0,25W	95619711
R3	"	93,1 K	1%	0,25W	95619863
R4	"	10 Ω	1%	0,25W	95619385
R5	"	7,50K	1%	0,25W	95619758
R7	"	62Ω	5%	0,25W	95618810
R17	"	14,7 Ω	1%	0,25W	95619401
R18	"	137Ω	1%	0,25W	95619591
R19	"	137Ω	1%	0,25W	95619591
R20	"	82,5Ω	1%	0,25W	95619570
R21	"	78,7Ω	1%	0,25W	95619568
R22	"	52,3Ω	1%	0,25W	95619551
R23	"	53,6Ω	1%	0,25W	95619552
R25	"	1K	1%	0,25W	95619674
R26	"	1K	1%	0,25W	95619674
R27	"	1,91K	1%	0,25W	95619701
R28	"	4,99K	1%	0,25W	95619741

CARTE INFERIEURE AMPLIFICATEUR DOUBLE OA 4571/0

OA 4571/0 TWIN AMPLIFIER LOWER CARD

Repère ITEM	Désignation COMPONENT				Référence Reference
	RESISTOR				
R29	RESISTANCE	93,1K	1%	0,25W	95619863
R30	"	10Ω	1%	0,25W	95619385
R31	"	7,50K	1%	0,25W	95619758
R37	"	14,7 Ω	1%	0,25W	95619401
R38	"	137 Ω	1%	0,25W	95619591
R39	"	137 Ω	1%	0,25W	95619591
R40	"	82,5 Ω	1%	0,25W	95619570
R41	"	78,7 Ω	1%	0,25W	95619568
R42	"	52,3 Ω	1%	0,25W	95619551
R43	"	53,6 Ω	1%	0,25W	95619552
R45	"	1K	1%	0,25W	95619674
R46	"	1K	1%	0,25W	95619674
R47	"	62Ω	5%	0,25W	95618810
	POTENTIOMETER				
R24	POTENTIOMETRE	5K	5%	1W	95732516
R44	"	5K	5%	1W	95732516
	CAPACITOR				
C1	CAPACITE	10PF		250V ± 1pF	95552248
C2	"	10PF		250V ± 1pF	95552248
	COMMUTATOR				
S1	COMMUTATEUR				94512307
S2	"				94512307

AMPLIFICATEUR OM 4509/2

OM 4509/2 AMPLIFIER

Repère ITEM	Désignation COMPONENT	Référence Reference
	INTEGRATED CIRCUIT	
IC1	CIRCUIT INTEGRE 301 A	95242042
	TRANSISTOR	
Q1	" 2N 2219A	95213231
Q2	" 2N 2905A	95212200
	DIODE	
CR1	" TF 23	95222200
CR2	" TF 23	95222200
CR3	" ZP 8,2	95222546
CR4	" ZP 8,2	95222546
CR5	" 1N 823	95221207
CR6	" 1N 823	95221207
CR7	" 1N 4448	95222854
CR8	" 1N 4448	95222854
CR9	" 1N 4448	95222854
CR10	" 1N 4448	95222854
	RESISTOR RESISTANCE	
R1	" 1,91 kΩ 0,25 W 1 %	95619701
R2	" 4,99 kΩ 0,25 W 1 %	95619741
R3	" 93,1 kΩ 0,25 W 1 %	95619863
R4	" 100 Ω 0,25 W 5 %	95612006
R5	" 1 kΩ 0,25 W 5 %	95613286
R7	" 200 Ω 0,25 W 5 %	95613305
R8	" 200 Ω 0,25 W 5 %	95613305
R9	" 10 kΩ 0,25 W 5 %	95612013
R10	" 10 kΩ 0,25 W 5 %	95612013
R11	" 1,1 kΩ 0,25 W 5 %	95613306
R12	" 1,1 kΩ 0,25 W 5 %	95613306

AMPLIFICATEUR OM 4509/2

OM 4509/2 AMPLIFIER
(suite)

Repère ITEM	Désignation COMPONENT	Référence Reference
	RESISTOR RESISTANCE	
R13	" 9,1 kΩ 0,25 W 5 %	95618822
R14	" 9,1 kΩ 0,25 W 5 %	95618822
R15	" 20 Ω 0,25 W 5 %	95660227
R16	" 27 Ω 0,25 W 5 %	95618808
R17	" 14,7 Ω 0,25 W 1 %	95619401
R18	" 137 Ω 0,25 W 1 %	95619591
R19	" 137 Ω 0,25 W 1 %	95619591
R20	" 82,5 Ω 0,25 W 1 %	95619570
R21	" 78,7 Ω 0,25 W 1 %	95619568
R22	" 52,3 Ω 0,25 W 1 %	95619551
R23	" 53,6 Ω 0,25 W 1 %	95619552
R25	" 1 kΩ 0,25 W 1 %	95619674
R26	" 1 kΩ 0,25 W 1 %	95619674
	POTENTIOMETER POTENTIOMETRE	
R6	" 5 kΩ 1 W 5 %	95732516
P24	" 5 kΩ 1 W 5 %	95732516
C1	CAPACITOR CONDENSATEUR 10 pF 250 V	95552248
S1	COMMUTATOR COMMUTATEUR	94512307

AMPLIFICATEUR OM 4509/4

OM 4509/4 AMPLIFIER

Repère ITEM	Désignation COMPONENT	Référence Reference
	INTEGRATED CIRCUIT	
IC1	CIRCUIT INTEGRE LM 308 A	95232203
	TRANSISTOR	
Q1	" 2N 2219A	95213231
Q2	" 2N 2905A	95212200
	DIODE	
CR1	" TF 23	95222200
CR2	" TF 23	95222200
CR3	" ZP 8,2	95222546
CR4	" ZP 8,2	95222546
CR5	" 1N 823	95221207
CR6	" 1N 823	95221207
CR7	" 1N 4448	95222854
CR8	" 1N 4448	95222854
CR9	" 1N 4448	95222854
CR10	" 1N 4448	95222854
	RESISTOR RESISTANCE	
R1	" 19,1 kΩ 0,25 W 1 %	95619797
R2	" 49,9 kΩ 0,25 W 1 %	95619837
R3	" 931 kΩ 0,25 W 1 %	95614516
R4	" 100 Ω 0,25 W 5 %	95612006
R5	" 1 kΩ 0,25 W 5 %	95613286
R7	" 200 Ω 0,25 W 5 %	95613305
R8	" 200 Ω 0,25 W 5 %	95613305
R9	" 10 kΩ 0,25 W 5 %	95612013
R10	" 10 kΩ 0,25 W 5 %	95612013
R11	" 1,1 kΩ 0,25 W 5 %	95613306
R12	" 1,1 kΩ 0,25 W 5 %	95613306

AMPLIFICATEUR OM 4509/4

OM 4509/4 AMPLIFIER
(suite)

Repère ITEM	Désignation COMPONENT	Référence Reference
	RESISTOR RESISTANCE	
R13	" 9,1 kΩ 0,25 W 5 %	95618822
R14	" 9,1 kΩ 0,25 W 5 %	95618822
R15	" 20 Ω 0,25 W 5 %	95660227
R16	" 27 Ω 0,25 W 5 %	95618808
R17	" 14,7 Ω 0,25 W 1 %	95619401
R18	" 137 Ω 0,25 W 1 %	95619591
R19	" 137 Ω 0,25 W 1 %	95619591
R20	" 82,5 Ω 0,25 W 1 %	95619570
R21	" 78,7 Ω 0,25 W 1 %	95619568
R22	" 52,3 Ω 0,25 W 1 %	95619551
R23	" 53,6 Ω 0,25 W 1 %	95619552
R25	" 1 kΩ 0,25 W 1 %	95619674
R26	" 1 kΩ 0,25 W 1 %	95619674
	POTENTIOMETER POTENTIOMETRE	
R6	" 5 kΩ 1 W 5 %	95732516
P24	" 5 kΩ 1 W 5 %	95732516
C1	**CAPACITOR** CONDENSATEUR 10 pF 250 V	95552248
S1	**COMMUTATOR** COMMUTATEUR	94512307

AMPLIFICATEUR OM 4509/1
OM 4509/1 AMPLIFIER

Repère ITEM	Désignation COMPONENT	Référence Reference
	INTEGRATED CIRCUIT	
IC2	CIRCUIT INTEGRE LM 308 AH	95242532
	CAPACITOR CONDENSATEUR	
C1	" 10 µF 16 V 20 %	95562274
C2	" 10 µF 16 V 20 %	95562274
C3	" 10 µF 16 V 20 %	95562274
C4	" 15 pF 200 V 20 %	95562004
C5	" 10 µF 6 V	95565951
C6	" 10 µF 6 V	95565951
C7	" 0,22 µF 63 V	95577191
	DIODE	
CR1	" TF 23	95222200
CR2	" TF 23	95222200
CR3	" 1N 941	95221244
CR4	" 1N 941	95221244
CR5	" TF 51	95222854
CR6	" TF 51	95222854
CR7	" TF 51	95222854
CR8	" TF 51	95222854
	RESISTOR RESISTANCE	
R1	" 100 kΩ 1/4 W 1 %	95619866
R2	" 100 kΩ 1/4 W 5 %	95612006
R3	" 1,2 kΩ 1/4 W 5 %	95613287
R4	" 1 kΩ 1/4 W 5 %	95613286
R5	Potentiometer Potentiomètre 5 kΩ 1 W 5 %	95732516
R6	INUTILISEE UNUSED	
R7	" INUTILISEE UNUSED	

AMPLIFICATEUR OM 4509/1

OM 4509/1 AMPLIFIER

(suite)

Repère ITEM	Désignation COMPONENT				Référence Reference
	RESISTOR RESISTANCE (suite)				
R8	"	10 kΩ	1/4 W	5 %	95612013
R9	Potentiometer Potentiomètre	2,2 kΩ	2 W	5 %	95730106
R10	Résistance	182 Ω	1/4 W	1 %	95619603
R11	Resistor	12,7 Ω	1/4 W	1 %	95619395
R12	"	121 Ω	1/4 W	1 %	95619586
R13	"	470 Ω	1/4 W	5 %	95612008
R14	"	330 Ω	1/4 W	5 %	95612022
R15	"	10 kΩ	1/4 W	5 %	95612013
R16	"	330 Ω	1/4 W	5 %	95612
R17	"	6,2 kΩ	1/4 W	5 %	95612142
R18	"	6,2 kΩ	1/4 W	5 %	95612142
R19	"	INUTILISEE	UNUSED		
R20	"	INUTILISEE	UNUSED		
R21	"	47 Ω	1/4 W	1 %	95612004
R22	"	47 Ω	1/4 W	1 %	95612004
R23	"	200 Ω	1/4 W	1 %	95613305
R24	"	200 Ω	1/4 W	1 %	95613305
R25	"	121 Ω	1/8 W	1 %	95619586
R26	"	1,5 kΩ	1/8 W	1 %	95613288

CONDITIONNEUR PONT DE JAUGES OM 4509/3

OM 4509/3 STRAIN JAUGE CONDITIONER

Repère ITEM	Désignation COMPONENT	Référence Reference
	POTENTIOMETER	
R35	POTENTIOMETRE 470 Ω 20 %	95713006
R36	RESISTANCE 9,76 kΩ 1/8 W 1 %	95619769
R37	Resistor 10 kΩ 1/8 W 1 %	95619770
R39	" 4,99 kΩ 1/8 W 1 %	95619741
R42	" 10 Ω 1/4 W 5 %	95612001
R43	" 10 Ω 1/4 W 5 %	95612001
R44	" 100 Ω 1/2 W 5 %	95612224
	CAPACITOR	
	CONDENSATEUR	
C2	" 10 pF 250 V	95552248
C3	" 47 pF 250 V	95552007
C4	" 10 µF 16 V	95562274
C5	" 10 µF 25 V	95562279
C6	" 10 µF 25 V	95562279
	INVERTER	
S4	INVERSEUR	94572097
	INTEGRATED CIRCUIT	
IC1	CIRCUIT INTEGRE LM 308 AH	95242532
	TRANSISTOR	
Q1	" 2N 2219A	95213231
Q2	" 2N 2905A	95212200
	DIODE	
CR3	" 1N 4448	95222854
CR4	" 1N 4448	95222854
CR5	" 1N 4448	95222854
CR6	" 1N 4448	95222854
	INTEGRATED CIRCUIT	
	CIRCUIT INTEGRE	
IC2	" 301 A	95242042
IC3	" LM300	95242039

CONDITIONNEUR PONT DE JAUGES OM 4509/3

OM 4509/3 STRAIN JAUGE CONDITIONER

(suite)

Repère ITEM	Désignation COMPONENT					Référence Reference
Q3	TRANSISTOR 2N 2905A					95212200
	DIODE					
CR1	" TF23					95222200
CR2	" TF23					95222200
	POTENTIOMETER					
R28	POTENTIOMETRE 1	kΩ		20 %		95713008
R29	RESISTANCE 4,7	kΩ	1/4 W			95613294
R30	Resistor 4,7	kΩ	1/4 W			95613294
R31	" 4,7	Ω	1/4 W			95613328
R16	" 9,1	kΩ	1/4 W	5 %		95618822
R17	" 9,1	kΩ	1/4 W	5 %		95618822
R18	" 15	Ω	1/4 W	5 %		95618801
R19	" 15	Ω	1/4 W	5 %		95618801
R20	" 107	Ω	1/8 W	1 %		95619581
R21	" 174	Ω	1/8 W	1 %		95619601
R22	" 82,5	Ω	1/8 W	1 %		95619570
R23	" 76,8	Ω	1/8 W	1 %		95660425
R24	" 52,3	Ω	1/8 W	1 %		95619551
R25	" 53,6	Ω	1/8 W	1 %		95619552
R26	" 14,7	Ω	1/8 W	1 %		95619401
R27	Potentiomètre 2	kΩ	0,6 W	5 %	Potentiometer	95730515
R32	Résistance 100	Ω	1/8 W	1 %	Resistor	95619578
R33	Potentiomètre 5	kΩ	1 W	± 5 %	Potentiometer	95732516
R34	Résistance 1,4	kΩ	1/8 W	1 %	Resistor	95619688
R38	Potentiomètre 5	kΩ	1 W	± 5 %	Potentiometer	95732516
R40	Résistance 38,3	Ω	1/8 W	1 %	Resistor	95619441
R41	" 82,5	Ω	1/8 W	1 %		95619570
R45	" 68,1	Ω	1/8 W	1 %		95619562
R46	" 107	Ω	1/8 W	1 %		95619581

CONDITIONNEUR PONT DE JAUGES OM 4509/3

OM 4509/3 STRAIN JAUGE CONDITIONER

(suite)

Repère ITEM	Désignation COMPONENT				Référence Reference
	RESISTOR RESISTANCE				
R47	"	118 Ω	1/8 W	1 %	95619585
R48	"	95,3 Ω	1/8 W	1 %	95619576
R49	"	110 Ω	1/8 W	1 %	95619582
C1	CAPACITOR CONDENSATEUR	10 pF	250 V		95552248
	COMMUTATOR COMMUTATEUR				
S1	"				94512307
S2	"				94512272
S3	INVERTER INVERSEUR				94572097

ENSEMBLE TEMPORISATEUR DE DEFILEMENT OM 4521/0

OM 4521/0 PAPER DRIVE TIME PRESELECTOR

Repère ITEM	Désignation COMPONENT	Référence Reference
	CONNECTOR	
J10	CONNECTEUR 6C	94412045
J11	" 6C	94412060
	BLACK KNOB	
	BOUTON D3 NOIR	97112097
	CAPSULE NOIRE POUR BOUTON KNOB BLACK COVER	97112508

CARTE INFERIEURE TEMPORISATEUR OM 4521/0

OM 4521/0 PAPER DRIVE TIME PRESELECTOR - LOWER CARD

Repère ITEM	Désignation COMPONENT				Référence Reference
	INTEGRATED CIRCUIT				
IC1	CIRCUIT INTEGRE	LM 555ON OU NE 555V			95242551
IC2	" "	SN 74L90			95232616
IC3	" "	SN 74L90			95232616
	RESISTOR				
Q1	TRANSISTOR	2N 2222A			95212216
CR1	DIODE	1N 4448			95222854
	RESISTOR				
R1	RESISTANCE	10K	5%	0,25W	95612013
R2	"	2,2K	5%	0,25W	95612009
R3	"	1K	5%	0,25W	95613286
R4	"	120K	5%	0,25W	95613319
R6	"	10K	5%	0,25W	95612013
R7	"	10Ω	5%	0,25W	95612001
R8	"	10Ω	5%	0,25W	95612001
R9	"	4,32K	1%	0,25W	95619735
	POTENTIOMETER				
R5	POTENTIOMETRE	1K	20%	0,75W	95713099
	CAPACITOR				
C1	CAPACITE	1µF		35V	95560035
C2	"	0,01µF		40V	95552252
C3	"	1µF	5%	63V	95573069
C4	"	0,01µF		40V	95552252
C5	"	0,01µF		40V	95552252
	RELAY				
K1	RELAIS	MS 13			94612190

CARTE SUPERIEURE TEMPORISATEUR OM 4521/0

OM 4521/0 PAPER DRIVE TIME PRESELECTOR - UPPER CARD

Repère ITEM	Désignation COMPONENT				Référence Reference
Q5	TRANSISTOR	2N 2222A			95212216
Q6	"	2N 2222A			95212216
Q7	"	2N 2222A			95212216
	ZENER DIODE				
CR5	DIODE ZENER				95222560
	RESISTOR				
R15	RESISTANCE	150K	5%	0,25W	95613299
R16	"	220K	5%	0,25W	95613320
R17	"	220K	5%	0,25W	95613320
R18	"	240K	5%	0,25W	95618842
R19	"	470K	5%	0,25W	95618834
R20	"	470K	5%	0,25W	95618834
R21	"	470K	5%	0,25W	95618834
R22	"	430K	5%	0,25W	95618833
R23	"	910K	5%	0,25W	95613300
R24	"	910K	5%	0,25W	95613300
R25	"	910K	5%	0,25W	95613300
R26	"	4,3K	5%	0,25W	95618821
R27	"	2,2K	5%	0,25W	95612009
R28	"	1K	5%	0,25W	95613286
R29	"	1K	5%	0,5 W	95612243
R30	"	4,3K	5%	0,25W	95618821
	CAPACITOR				
C10	CAPACITE	0,01µF		40V	95552252
	COMMUTATOR				
S1	COMMUTATEUR				94512309
S2	"				94542018

ADAPTATEUR OM 4510/1

OM 4510/1 ADAPTOR

Repère ITEM	Désignation COMPONENT	Référence Reference
	POTENTIOMETER POTENTIOMETRE	
P1	" 5000 Ω 205 - 207 V	95732516
P2	" 200 Ω 205 - 207 V	95732515
	RESISTOR RESISTANCE	
R1	" 301 Ω 1/4 W 1 %	95619624
R2	" 75 Ω 1/4 W 1 %	95619566

ADAPTATEUR OM 4510/2

OM 4510/2 ADAPTOR

Repère ITEM	Désignation COMPONENT	Référence Reference
	POTENTIOMETER POTENTIOMETRE	
P1	" 5000 Ω 205 - 207 V	95732516
	RESISTOR RESISTANCE	
R1	" 301 Ω 1/4 W 1 %	95619624

ATTENUATEUR OM 4510/3

OM 4510/3 ATTENUATOR

Repère ITEM	Désignation COMPONENT	Référence Reference
	CONNECTOR CONNECTEUR	
	" 3 br. males	91413028
	" 3 br. femelles	91413022
	RESISTOR RESISTANCE	
R1	" 108,1 kΩ 1/4 W 0,5 %	95660175
R2	" 997,6 kΩ 1/4 W 1 %	95660280
R3	" 2,04kΩ 1/4 W 0,5 %	95660174

ATTENUATEUR OM 4510/4

OM 4510/4 ATTENUATOR

Repère Item	Désignation Component				Référence Référence
	CONNECTOR				
	CONNECTEUR				
	"	5 br mâles			94413033
	"	5 br femelles			94412818
	RESISTOR				
	RESISTANCE				
R1	"	2,04 kΩ	0,25 W	0,5%	95660174
R2	"	108,1 kΩ	0,25 W	0,5%	95660175
R3	"	997,6 kΩ	0,25 W	1%	95660280

ATTENUATEUR OM 4510/5

OM 4510/5 ATTENUATOR

Repère Item	Désignation Component				Référence Référence
	CONNECTOR CONNECTEUR				
	"	3 br mâles			9413028
	"	3 br femelles			94413022
	RESISTOR RESISTANCE				
R1	"	2,04 k	0,25 W	0,5%	95660174
R2	"	18,2 k	0,12 W	1%	95619795
R3	"	997,6 k	0,25 W	1%	95660280

CARTE REGULATION

REGULATOR CARD

Repère Item	Désignation Component				Référence Référence
	RESISTOR				
	RESISTANCE				
R1	"	22 KΩ	5 %	0,25 W	95612015
	CAPACITOR				
	CONDENSATEUR				
C1	"	1 MF	20 %	35 V	95562002
	DIODE ZENER				
CR1	"	10 V	5 MA		95222555
	INTEGRATED CIRCUIT				
	CIRCUIT INTEGRE				
IC1	"		MC 7812 CP		95242546

MP MASTER
MA24424